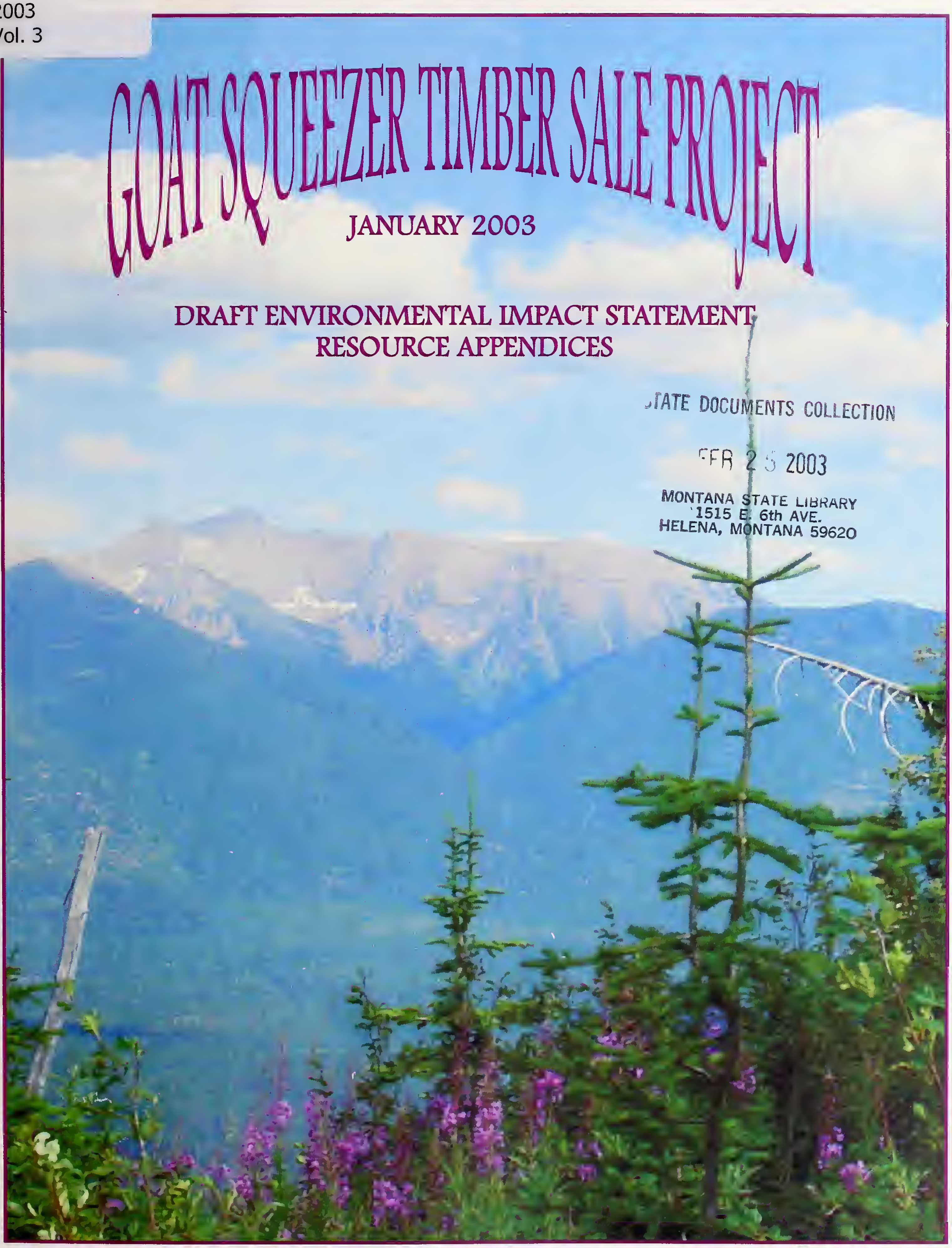
GOAT SQUEEZER TIMBER SALE PROJECT

JANUARY 2003

DRAFT ENVIRONMENTAL IMPACT STATEMENT
RESOURCE APPENDICES



Department of Natural Resources and Conservation
Swan River State Forest

DEPARTMENT OF
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GOAT SQUEEZER TIMBER SALE PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT
January 21, 2003

Enclosed is a copy of the Goat Squeezer Timber Sale Project Draft Environmental Impact Statement (DEIS) Executive Summary. I encourage you to carefully review the information presented in the Summary and provide comments to Karen Jorgenson, Project Leader, Swan State Forest, 58741 Highway 83 South, Swan Lake, Montana 59911. Comments must be received by February 21, 2003. Along with your comments, please include your name, address, telephone number, and the title of the DEIS for which you are providing comments. If, after reading the Summary, you would like to obtain the complete DEIS, contact Karen at the address listed above, phone (406) 754-2301, or view the DEIS on the Department of Natural Resource and Conservation's web page: http://www.dnrc.mt.us.

The proposed project is located approximately 9 miles southeast of Swan Lake, Montana in Swan River State Forest.

The Department does not present a preferred alternative of the two action alternatives analyzed in the DEIS. Proposed harvest volumes range from 0 million board feet (MMBF) in No-Action Alternative A, to 13.4 MMBF in Action Alternative B, and 10.2 MMBF in Action Alternative C.

The DEIS was designed to address Swan River State Forest's primary commitment to Montana's mandated timber-harvest levels over a three-year period. This approach does a better job of analyzing cumulative effects to valuable resources and improves project-planning coordination within active subunits scheduled by the Swan Valley Grizzly Bear Conservation Agreement.

The DEIS is written in the format that can be understood by any interest level and incorporates pictures in the Summary to promote project understanding. The DEIS consolidates Chapters III and IV into one section that plainly summarizes the analysis. The bulk of the scientific analysis is located in the tabbed appendices. The information in the appendices must be used for scientific, technical, or legal review. This format has improved our ability to communicate with all individuals interested in the management of State lands. I welcome your thoughts and comments.

Sincerely,

Robert L Sandman

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INTRODUCTION
TO RESOURCE APPENDICES
FOR THE GOAT SQUEEZER TIMBER SALE PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

The following resource appendices are a part of the Goat Squeezer Timber Sale Project DEIS, which has been bound separately. The ID Team members prepared the resource appendices; the discussions include citations from other sources such as research documents, environmental assessments, etc. The lengthy technical discussions of methodologies, research, monitoring, baseline studies, analyses, etc., completed by the ID Team are presented in these appendices. The information in the appendices would need to be utilized for any scientific, technical, or legal review.

APPENDIX A

LIST OF RELATED ENVIRONMENTAL REVIEWS

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX A

LIST OF RELATED ENVIRONMENTAL REVIEWS

INTRODUCTION

In order to address direct, indirect, and cumulative effects on a landscape level, the analysis must incorporate past, present, and future actions within the analysis area. The following activities are located within the Goat Squeezer environmental analysis area for vegetation on Swan River State Forest. The environmental analysis areas for watershed, wildlife, soils, and fisheries are smaller in size and encompass an area specific to those disciplines.

DNRC TIMBER SALE AND ROAD PROJECTS

State timber sales where environmental analyses have been completed and sale activities have begun or have been completed:

- South Wood Timber Sale EIS (completed in 2002)
- Small Squeezer Timber Sale (Checklist Environmental Assessment [EAC]) completed in 1999
- Small Squeezer II Timber Sale (EAC completed in 2000)
- High Blow '02 Salvage
- Soup Creek Salvage
- Multiple small salvage permits have been sold over the last several years. The project file contains a list.

State timber sale proposals with environmental reviews in progress:

- Old Whitetail Timber Sale Project Proposal (currently on hold)
- Cilly Creek Salvage
- Napa Lookout Permit
- Big Blowdown Salvage

The proposed Lost Cilly Soup Timber Sale Project is identified on DNRC's 3-Year Listing as the next potential project for Swan River State Forest, but, as yet, has no initial proposal or proposed action. The potential project has not been scoped; therefore, DNRC has not initiated a preimpact study on this proposal.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT

Beginning in December 1994, DNRC participated in the development of the SVGBCA with the United States Fish and Wildlife Service (USFWS), Flathead National Forest (FNF), and Plum Creek Timber Company. The SVGBCA seeks to cooperatively manage grizzly bear habitat in Swan Valley, where intermingled-ownership patterns and differing land-management objectives complicate habitat management for a species as wide ranging as the grizzly bear. The USFWS evaluated the SVGBCA in an environmental assessment (EA) and found that implementing the management guidelines in the agreement would not negatively impact grizzly bears (*USFWS 1995*).

The Goat Squeezer Timber Sale Project area is within the conservation area delineated in the SVGBCA and complies with its guidance.

OTHER ACTIVITIES

Reciprocal access agreements with Plum Creek Timber Company that may affect resources in the Goat Squeezer Timber Sale Project area include the Van Peak Road in Section 36, T23N, R17W.

DNRC is requesting from USFS permanent access through the Forest Road and Trail Agreement across Section 17, T23N, R17W (FR 554 and other USFS connector roads) and Section 5, T22N, R17W (FR 9758).

Another activity on adjacent ownership that may affect resources within the Goat Squeezer Timber Sale Project area is ongoing logging on land owned by Plum Creek Timber Company.

Stipulations &
Specifications

APPENDIX B

STIPULATIONS AND SPECIFICATIONS

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX B

STIPULATIONS AND SPECIFICATIONS

INTRODUCTION

The stipulations and specifications for Action Alternatives B and C were identified or designed to prevent, or reduce, the potential effects to the resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification and resource concerns. This section is organized by resource.

Stipulations and specifications that apply to operations required by the contract and occurring during the contract period will be contained within the Timber Sale Contract. As such, they are binding and enforceable. Project administrators enforce stipulations and specifications for all activities relating to the project that may occur during or after the contract period.

TABLE OF CONTENTS

The following stipulations and specifications are incorporated into all action alternatives to mitigate the potential effects on resources.

➢ **WATERSHED AND FISHERIES**

- Management standards of the SMZ Law (*75-5-301, MCA*) are implemented. SMZs would be delineated where they occur within or adjacent to harvest areas to protect areas adjacent to streams or lakes to maintain water quality. In addition, ground-based equipment is restricted to 50 feet from all wetlands and ponds or to locations above slope breaks if they exist within 50 feet of the edge of a wetland or pond.
- Brush would be removed from existing road prisms to allow effective road maintenance. Improved road maintenance would reduce sediment delivery.
- Equipment leaking fluids would not be permitted to operate at stream-crossing construction sites.
- The contractor would be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that would affect water quality.
- Culvert sizing for all road projects would be for a 50-year flood event, as recommended by a DNRC hydrologist.
- Stream crossings where culvert removals and installations are

planned would have the following requirements, as needed, to protect water quality and meet BMPs:

- Filter-fabric fences would be in place downstream prior to and during culvert installation.
- Diversion channels would be constructed and lined with plastic to divert streamflow prior to any in-channel operations.

• Planned erosion-control measures include:

- grade breaks on roads;
- surface-drainage devices on roads;
- slash-filter windrows; and
- grass seeding.

Included in the project proposal are the following pertinent recommendations of the *Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program Final Report, June 1991*.

The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154-162 of the Final Report.

1. BMPs are incorporated into the project design and operations of the proposed project.

2. Riparian indicators would be considered in the layout of the harvest units.

3. Management standards of the SMZ are used in conjunction with the recommendations of the study.

4. The BMP audit process would continue. This sale would likely be reviewed in an internal audit and may be randomly chosen as a Statewide audit site.

7. SMZs would be evaluated as part of the audit process.

12. Watershed-level planning and analysis are completed. Logging plans of other agencies and private companies are used.

14. DNRC is cooperating with DFWP on the further study of fish habitat and populations for Goat and Squeezer creeks.

15. DNRC would use the best available methods for logging and road building for this project.

16A. Existing roads are fully utilized for this proposal and brought up to BMP standards.

16B. DNRC utilizes BMPs, transportation planning, and logging system design to minimize new road construction.

17. DNRC contracts with DFWP to obtain species composition, spawning inventory, and spawning habitat quality for Goat and Squeezer creeks. DNRC's mitigation plan for roads fits all recommendations for "impaired" streams. Using "worst-case scenario" criteria provides for conservative operations in this proposal.

18. Provisions in the Timber Sale Contract address BMPs, which are rigidly enforced.

20. Planning for the long-term monitoring of Goat and Squeezer creeks, as well as other streams on Swan River State Forest.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC would continue to monitor fisheries on Swan River State Forest in the future as funding allows.

➢ **GRIZZLY BEARS**

• All action alternatives would meet the intent of the SVGBCA.

• Grass seed roads and landings to revegetate with plant species less palatable to

grizzly bears to discourage or minimize the potential for bear-human conflicts.

- Contractors are required to haul or store garbage in a safe place so bears would not be attracted to the area.
- No logging camps are allowed within the sale area.
- The Forest Officer would immediately suspend activities directly related to the proposed action to prevent imminent confrontation or conflict between grizzly bears and humans, or other threatened or endangered species and humans.
- Contractors would be prohibited from carrying firearms onto closed roads while working under contract.
- When possible, healthy trees that are not big enough to be harvested would be retained to provide screening.

➢ WOLVES

Contract provisions would protect any wolf den or rendezvous site within the gross sale area that may be discovered during implementation of this proposal.

➢ BIG GAME

The purchaser is authorized to enter the project area with motorized vehicles only for purposes related to the performance of the contract. Road use is restricted to nonmotorized transportation beyond any road closure for any other purpose. Motorized vehicle entry for purposes other than contract performance, such as hunting or transporting game animals, would be considered in trespass and prosecuted to the fullest extent of the law (*ARM 45-6-203*).

➢ WILDLIFE TREES AND SNAG RETENTION AND RECRUITMENT

- Snag-retention guidelines would retain at least the minimum mean number of snags (less than 15 inches diameter at breast height [dbh]) per acre that are occurring on uncut plots (by habitat-type group), as reported in *Harris (1999)*.
- All ponderosa pine and western larch snags greater than 21 inches dbh would be retained. If more snags are needed to meet the *Harris (1999)* requirements, the next largest ponderosa pine and western larch snags would be retained. If these species are lacking, other species could be substituted.
- In addition to these retention requirements, all cull trees would be left standing. Cull ponderosa pine and western larch can be counted toward meeting the snag requirements, but other species cannot.

➢ VISUALS

- Damaged residual vegetation would be slashed.
- The size and number of landings would be limited; the location would be away from main roads when possible.
- Disturbed sites along road rights-of-way would be grass seeded.
- When possible, healthy trees that are not big enough to be harvested would be retained.

➢ CULTURAL RESOURCES

- A contract clause provides for suspending operations if cultural resources are discovered; operations may only resume when directed to do so by the Forest Officer.

- A DNRC archaeologist conducted a review of the project.

SOILS

COMPACTION

- Logging equipment would not operate off forest roads unless soil moisture at 6 inches is less than 20 percent, soil frozen to a depth of at least 4 inches, or snow cover is a minimum depth of 18 inches. These conditions usually prevent soil compaction, rutting, or displacement.
- Existing skid trails and landings would be used when their design is consistent with prescribed treatments and they meet current BMP guidelines.
- The logging foreman and sale administrator would agree to a skidding plan prior to operating equipment.
- The density of skid trails in a harvest area would not exceed 20 percent of the total area in a harvest unit.

SOIL DISPLACEMENT

- Conventional ground-based skidding equipment would not be operated on slopes steeper than 40 percent. Soft-tracked yarding has less impact than conventional tractor skidding on slopes up to 55 percent. Cable yarding would be used on the steeper slopes.
- Slash piling and scarification would be completed with a dozer where slopes are gentle (less than 35 percent). Slash treatment and site preparation would be done with an excavator in areas where soils are wet and slopes are steeper, (up to 55 percent).

EROSION

- Ground-skidding machinery would be equipped with a winchline to limit equipment operations in wet areas and on steep slopes.
- To reduce surface erosion, roads used by the purchaser would be reshaped and the ditches redefined following use.
- Drain dips and gravel would be installed on roads, as needed, to improve road drainage and reduce maintenance and erosion.
- Some road portions would be repaired and upgraded to standards that reduce erosion potential and maintenance needs.
- The prompt and timely application of certified weed-free grass seed and fertilizer would be applied to all newly constructed road surfaces and cut-and-fill slopes, as well as any existing disturbed cut-and-fill slopes and landings immediately adjacent to open roads. This would be done to stabilize soils and reduce or prevent the establishment of noxious weeds and would include:
  - seeding all road cuts and fills concurrently with construction;
  - applying a "quick cover" seed mix at culvert installation sites within 1 day of work completion; and
  - seeding all road surfaces and reseeding culvert-installation sites when the final blading is completed for each specified road segment.
- As directed by the Forest Officer, water bars, logging-slash barriers, and temporary culverts would be installed on skid trails where, based on

ground and weather conditions, erosion is anticipated. These erosion-control features would be maintained and periodically inspected throughout the contract period, or extensions thereof.

AIR QUALITY

- To prevent individual or cumulative effects during burning operations, burning would be done in compliance with the Montana Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2. This would provide for burning during acceptable ventilation and dispersion conditions.
- To reduce effects from burning operations:
  - Dozer, excavator, landing, and roadwork debris would be piled clean of dirt and duff to allow the piles to burn hotter and with less smoke.
  - Burning would be done in the spring or fall when ventilation is good and surrounding fuels are wet.
  - The Forest Officer may require that piles be covered due to the higher relative humidity during spring and fall. Covered piles are drier, ignite easier, burn hotter, and extinguish sooner. This would reduce dispersed unentrained smoke.
- The number of piles to burn would be reduced by leaving large woody debris in the harvest units.

SENSITIVE PLANTS

Appropriate protection measures would be done so sensitive plant populations would not be disturbed. Riparian areas near proposed harvest units would be protected by marking SMZs and isolated wetlands. No harvesting is planned in SMZs, wetlands, or near springs on localized features. If sensitive plant populations are found, the appropriate habitat area would be excluded from the harvest units.

NOXIOUS WEED MANAGEMENT

To further limit the possibilities of spreading weeds, the following integrated weed-management mitigation measures of prevention and control would be implemented:

- All tracked and wheeled equipment are required to be clean of noxious weeds prior to beginning project operations. The contract administrator would inspect equipment periodically during project implementation.
- The prompt revegetation of disturbed roadside sites would be required. Roads used and closed as part of this proposal would be reshaped and seeded.
- Surface blading may be required on roads affected by the proposal to remove weeds before the seedset stage.
- Herbicide application, as designated by the forest officer, may be used to control weeds along roads that access the timber sale area.

HERBICIDES

To reduce risks to aquatic and terrestrial resources, the following would be required:

- All herbicides would be applied by licensed applicators in accordance with laws, rules, and regulations of the State of Montana and Lake County Weed District.
- All applications would adhere to BMPs and the herbicide's specific label guidelines.

- Herbicide applications would not be general, but site specific to areas along roads where noxious weeds grow. All no-spray areas would be designated on the ground before applications begin.

- Herbicides would not be applied to areas where relief may contribute runoff directly into surface water.

- Herbicides would be applied on calm, rainless days to limit drift and the possibility of the herbicide moving off the road prisms.

Vegetation

APPENDIX C

VEGETATION

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX C

VEGETATION ANALYSIS

INTRODUCTION

This section will provide a detailed description of the present conditions of the forest and address the potential effects of the proposed alternatives related to the following issues:

- Populations of Douglas-fir beetles may increase and potentially cause continued mortality if timber harvesting does not occur within infected or high-risk tree stands.
- Dense, overstocked stands might lead to decreased health, vigor, and productivity of shade-intolerant species (western larch, ponderosa pine, western white pine, Douglas-fir) due to competition from shade-tolerant species (grand fir, Engelmann spruce, subalpine fir, western red cedar).
- Timber harvesting may reduce habitat for sensitive plant species.
- Current covertypes may be adjusted where they do not agree with the historic or appropriate stand conditions.
- Harvesting could remove or change attributes of old-growth stands on Swan River State Forest.

BACKGROUND

The SFLMP directs DNRC to take a coarse-filter approach to biodiversity by favoring an appropriate mix of stand structures and compositions on State land (*DNRC 1996*). To implement a coarse-filter approach and meet SFLMP directives, landscape analysis techniques were used to determine an appropriate mix of stand structures and compositions, including forest covertype representation, age-class distribution, and structural characteristics.

ANALYSIS METHODS

The analysis will compare the desired stand conditions that DNRC believes to be appropriate for the site with current stand conditions and changes caused by each action alternative.

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Inventory data from the 1930s was used in *Losensky's 1993* analysis to provide an estimate of the age class distribution by covertype for Montana's forests pre-European settlement, prior to fire suppression and extensive logging. *Losensky (1997)* worked with DNRC to complete an analysis for the entire State. Some vegetation types specific to that work are included in this analysis.

The information used to assign covertypes is currently present in the SLI database for Swan River State Forest. Maps and spreadsheets of the information used in the analysis are in the project file. Copies of the information are available at the Swan River State Forest office.

ANALYSIS AREA

The analysis area is looked at on 3 scales: the Upper Flathead Valley, the Swan River State Forest management block, and the project area. Each level is looked at because of the connection between them. The project is within the State forest and directly affects the timber base and other attributes at the forest-management level. Swan River State Forest is part of the 333C climatic regime, which is associated with Upper Flathead Valley. This means the area is typically under the same weather influences, which is reflected in forest vegetation and age classes. It is important to consider each level because activities at 1 scale can have influences at all scales.

- Upper Flathead Valley – Historic conditions refer to those from Climatic Section 333C of the Upper Flathead Valley (*Losensky 1997*). For this analysis, the historic conditions for Climatic Section 333C relate only to forest covertypes and age-class distributions.
- Swan River State Forest management block – Current and appropriate conditions were analyzed on the scale of the entire Swan River State Forest, based on the Swan River State Forest SLI database file.
- Project area – Within the project area, the stands proposed for harvest entry will be analyzed by harvest unit for each alternative.

Analyses will use both the Swan River State Forest management block and the project-level analysis area throughout.

The SLI database is updated on an annual basis to include information corrections discovered in the field on a stand-level basis or to cover scheduled changes where harvesting activities have taken place. This update process provides DNRC foresters with the best available data for the required analysis on proposed management activities. Where ongoing and future timber sales have not yet received a postharvest inventory, probable effects are taken into consideration to address cumulative impacts in each analysis area. The display of effects will show the trends in covertype conversions and age-class distributions.

Within the analysis area, 2 other timber sales have been completed and 1 is in progress concurrently with the analysis of this sale. The estimated effects of this project on covertypes, age-class distributions, and old growth stands will be considered with the Small Squeezer, Small Squeezer II, and South Woodward timber sales in a cumulative-effects analysis for Swan River State Forest. Many salvage operations have taken place over several years and have reduced the number of large, sound snags across both the project area and Swan River State Forest. In stands of past salvage operations, the composition has been altered in the form of numbers and species of large snags. The structure of these stands is

also affected by the removal of the snag component.

EXISTING VEGETATION

The existing vegetative types on Swan River State Forest and within the project area are a result of various site factors, fire regimes, and past management practices.

SITE FACTORS

Site conditions vary depending on their geographic, physiographic, and climatic factors. These conditions include features such as:

- soil types,
- aspect (sites proposed for harvesting have a south, west, southwest, and northwest exposure),
- position on the landscape (the Goat Squeezer Timber Sale Project area is mainly located on the valley floor and lower slopes of the Swan Range)
- growing seasons, and
- moisture availability.

These variables were combined to develop the habitat-type classifications used to describe successional development and timber productivity, among other things (*Pfister et al, 1977*).

Forested stands within the project area were categorized using *Fischer and Bradley's* fire groups. Forest habitat types were assigned to 10 fire groups based on the response of the tree species to fire and the roles these tree species take during successional stages (*Fischer and Bradley, 1987*). The fire groups are also linked to the dominant weather associated with stand habitat types. Within the Goat Squeezer Timber Sale Project area, 75 percent of the habitat types are in the moderately cool and moist habitat-type group, which include some grand fir, Engelmann spruce, and western red cedar habitat types. Seventeen percent of the habitat types are in the moderately warm and dry habitat-type group, which include the majority of the Douglas-fir habitat types. Five percent are in the cool and moist habitat-type group, which includes the subalpine fir habitat type. The remaining percentages vary from wet to moderately cool and dry habitat-type groups, which include some Engelmann spruce, Douglas-fir, and grand fir habitat types.

Forest productivity is rated moderate to high on these sites. These sites are predominantly occupied with Douglas-fir, western larch, lodgepole pine, ponderosa pine, grand fir, and Engelmann spruce, with scattered representations of western red cedar and subalpine fir.

FIRE REGIMES

Since the 1930s, fire suppression has affected the stand structures in Swan River State Forest. This unmeasured effect is caused by suppressing lightning-caused fires that, prior to modern intervention, would have been influenced only by weather and climatic factors. These unsuppressed fires may have resulted in stand-replacing events when wind, drought, and high temperatures combined to form high-intensity burning conditions. Such conditions occur during summer drought periods in western Montana.

There has been no large-scale fires recorded in the project area since the late 1800s, though evidence shows signs that fire did occur in these areas by the presence of fire scars on trees, char pieces, and encroachment of shade-tolerant species under an older dominant canopy. In the more recent past, smaller-scale fires, such as spot fires (e.g., 20 feet by 20 feet in size), and fires up to 3,000 acres have occurred in the Goat Creek drainage. These fires were suppressed and not allowed to burn under natural conditions.

Habitat types have also been grouped

to indicate the severity and frequency of wildfires that historically may have occurred on a site (*Fischer and Bradley, 1987*). The majority of the proposed harvest units (75 percent) are in Fire Group 11; the next highest percentage are in Fire Group 6 (17 percent), and then Fire Group 9 (5 percent).

Fire Group 11, which is described as warm, moist grand fir, western red cedar, and western hemlock habitat types, is the dominant fire regime in the project area.

Stand-replacing fires are estimated to have occurred every 50 to 200 years. Less severe fires likely occurred more often and in broad locations, which would have helped maintain relict seral stands. Relict stands contain large trees that have survived fires of lower intensity; these rarely develop into true shade-intolerant stands due to the frequency of fires.

Fire Group 6 is a common fire regime in the project area. It is described as a moist Douglas-fir habitat type. Prior to European settlement, this group was a fire-maintained open forest. A typical fire interval ranged from 15 to 40 years, which maintained an open forest and kept brush at low levels. The frequent fires would favor western larch and ponderosa pine over the Douglas-fir habitat type. Also, common to this type of regime are stand-replacement fires that favor lodgepole pine.

Fire Group 9, a moist, lower elevation, subalpine fir habitat type, is also represented in the project area. Past studies show an average fire-free interval of 30 years, with extremes of 10 to 100 years. The dominant representation of ponderosa pine, western larch, and Douglas-fir may account for the high fire frequency. Due to the moisture content of these stands, moderate to severe fires may have been restricted to brief periods in the summer. Flare-ups may have caused openings that could have allowed the establishment of seral species.

PAST MANAGEMENT ACTIVITIES

Past inventory records show that timber harvesting has occurred in the project area beginning in the early 1950s.

The folowing information pertains to timber sales in and adjacent to the Goat Squeezer Timber Sale Project area between 1950 and 2002:

- Most of the harvesting in the project area occurred in the flatter areas east of Highway 83 at the base of the Swan Range. Regeneration harvests were conducted in harvest units 20 acres and larger between 1950 and 1970. The majority of the sale units have regenerated and are well stocked with a variety of sapling-/pole-sized tree species. Seedtree and clearcut harvesting between 1970 and 1992 have created 10- to 150-acre openings that have densely regenerated with 6- to 40-foot trees. Since the 1950s, ongoing salvage harvesting has taken place throughout the low-elevation areas.
- Stands in the valley bottom were primarily harvested with clearcut/ seedtree prescriptions beginning in the 1950s. These stands have regenerated to a variety of species that include western larch, Douglas-fir, western red cedar, western white pine, and grand fir. The regeneration is 15 to 30 feet tall and well-stocked to overstocked in most stands.
- Timber harvesting on adjacent Plum Creek Timber Company land is ongoing in Sections 3, 5, 7, 9, 15, 21, 23, 27, 29, 33, and 35, T23N, R17W. Most stands have been harvested using various treatment methods. Clearcut, seedtree, and selective harvest methods have typically been applied to hundreds of contiguous acres, creating

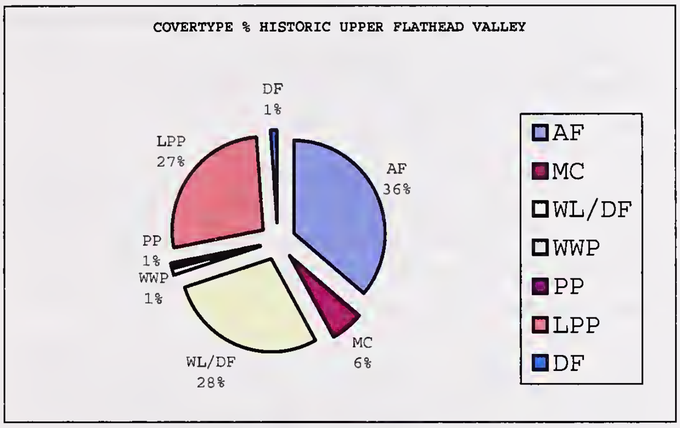
abrupt, straight edges that follow ownership boundaries along section lines.

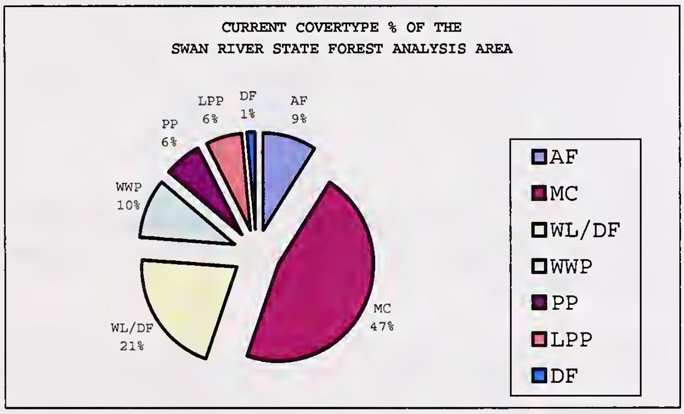
COVERTYPE REPRESENTATIONS FOR THE ANALYSIS AREA

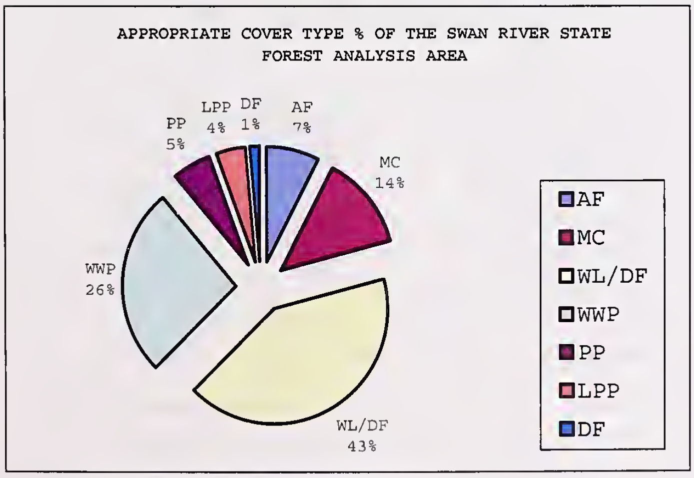
LANDSCAPE LEVEL (COARSE FILTER)

FIGURE C-1 illustrates the percentage of forested ground occupied by a particular covertype. The comparisons shown include the Upper Flathead Valley Climatic Section historic data and the current and appropriate conditions on the scale of Swan River State Forest.

FIGURE C-1







Data indicates that mixed-conifer stands are currently overrepresented in reference to conditions that DNRC has identified as appropriate by using historic data at the climatic-section level. The data is adjusted for Swan River State Forest conditions by analysis of the SLI. Many species that make up the mixed-conifer covertype are shade tolerant and increase in the species component of stands as the interval between disturbances, such as wildfire, is lengthened. The subalpine fir, lodgepole pine, and ponderosa pine covertypes are also slightly overrepresented.

The western larch/Douglas-fir and western white pine covertypes are currently underrepresented on Swan River State Forest in reference to desired, or appropriate, covertypes, but each for different reasons. Western larch and ponderosa pine are not shade tolerant, and Douglas-fir is less shade tolerant than true firs. Shade-tolerant species (Engelmann spruce, grand fir, subalpine fir, etc.) are encroaching to make up the mixed-conifer covertype. Douglas-fir, ponderosa pine, and western larch have historically been perpetuated through fairly intensive disturbances, such as wildfires, and when mature, are more resistant to fire mortality than other species. Lack of moderate-intensity and stand-replacing fires since the advent of fire suppression, along with the normal temporal and spatial variation in fire occurrence, have combined to increase the development of mixed-conifer stands within the Douglas-fir/western larch covertype.

Western white pine has declined dramatically as a component of the species mix in which it historically occurred on Swan River State Forest. The primary cause is white pine blister rust, a disease caused by

Cronartium ribicola, a nonnative fungus. This pathogen was introduced into western North America in the early 1900s and quickly spread across the native range of western white pine. In addition to mortality caused by white pine blister rust, extensive harvesting and fire suppression have also contributed to the reduction in the white pine forest type (*Fins et al. 2001*). Loss of white pine has resulted in a conversion of most of the historic white pine covertype to a mixed-conifer covertype, dominated by mid- to late-seral species such as grand fir, Douglas-fir, western hemlock, and western red cedar (*Byler and Hagle, 2000*). However, a long-term breeding program, in place since the 1950s, has selected naturally occurring rust-resistant genes from within the native western white pine (*Bingham 1983*). The result has been the availability of rust-resistant western white pine planting stock (*Fins et al. 2001*). This stock is not immune to rust infection, but are infected and killed less frequently than natural regeneration and tolerate infections better when they do occur. Rust-resistant western white pine has become the basis for the restoration of western white pine (*Fins et al. 2001*).

The restoration of ponderosa pine is an objective of this timber sale. Due to nearly a century of fire suppression, these stands are developing a dense understory, primarily Douglas-fir, resulting in sparse regeneration of ponderosa pine and an apparent loss of vigor in the overstory ponderosa pine due to the combined effects of competition and drought. This loss of vigor makes ponderosa pine more vulnerable to attack by various species of bark beetles (*Paine and Baker, 1993*). In addition, the development of the Douglas-fir understory has likely led to an increase in levels of Armillaria root disease inoculum. Ponderosa pine is considered moderately susceptible to infection and damage by Armillaria root disease on most sites, while Douglas-fir is considered highly susceptible (*Hodfield et al. 1986*). However, increasing evidence of root disease in the more susceptible Douglas-fir makes it more likely that Armillaria root disease will be able to overwhelm the large-diameter, overstory ponderosa pine, particularly when they are already stressed by drought and dense understory competition. In fact, Armillaria root disease is already killing scattered individuals of the large-diameter ponderosa pine within these stands (*Brennan Ferguson, DNRC Contract Forest Pathologist, personal observation*).

In order to improve the vigor of the overstory ponderosa pine and promote natural regeneration that will maintain these stands, it will be necessary to provide full sunlight to the forest floor through understory removal, reintroduction of fire, and creation of some small gaps in the overstory. With this course of action, restoration and maintenance of ponderosa pine could be successful.

AGE CLASS

AGE-CLASS DISTRIBUTION ON SWAN RIVER STATE FOREST (LANDSCAPE-LEVEL COARSE FILTER)

Age-class distributions are another important characteristic for determining the average historical, or appropriate, conditions. When age-class distributions are combined with information on covertypes, a fairly clear picture emerges over time of the average forest conditions. Knowledge of local topographical effects, ecological characteristics of tree species, climatic vegetation relationships, and disturbance regimes helps to define appropriate conditions.

Inventories of the 1930s quantified the ages of the forest stands.

Losensky examined the data and projected the stands back in time to the early 1900s. This data is useful in setting baseline conditions for determining the extent that current forest age-class distribution deviates from historical conditions.

FIGURE C-2 compares the current distribution of age classes on the Swan River State Forest management block with the historical conditions from the Upper Flathead Valley analysis area. Also shown is the age-class distribution following each action alternative.

Comparing the entire Swan River State Forest with historical data from the Upper Flathead Valley shows that Swan River State Forest is lower in stands of the seedling/ sapling age class and higher in stands of the 150-year-and-older age class, relative to historic conditions. This can be explained by the lack of large-scale, stand-replacing fires on Swan River State Forest over the past 90 years and the limited logging entries that replaced mature stands with seedling/sapling-sized stands.

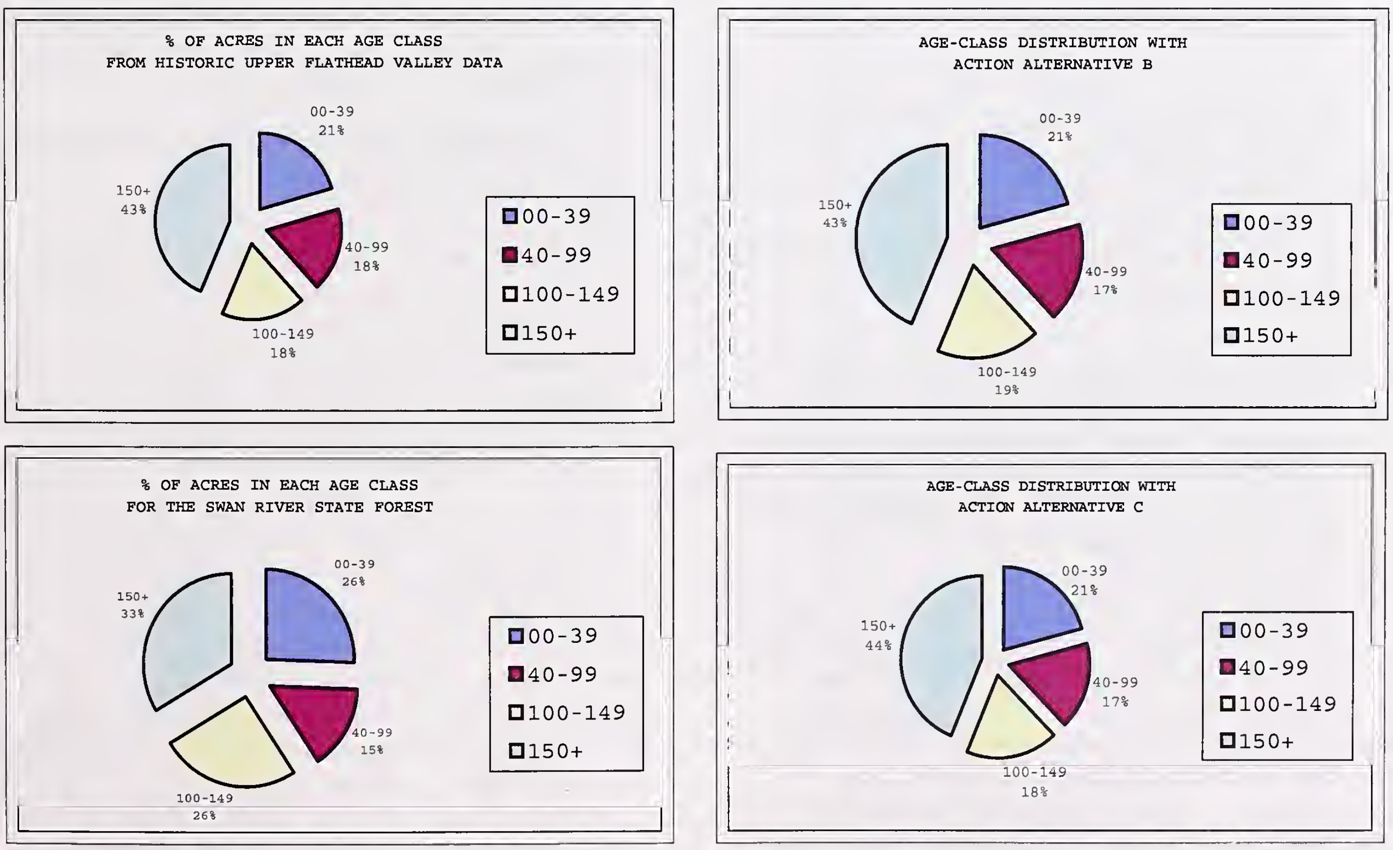
ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effect of No-Action Alternative A to Covertypes and Age Classes***

  The western larch/Douglas-fir and western white pine covertypes would continue to be represented at levels lower than historical amounts. Shade-tolerant trees would continue to regenerate under closed-canopy forests. The long-term covertype effects would see a change to a shade-tolerant dominated overstory. This would change the covertype classification to the dominant species in the next successional stage of the stand.

FIGURE C-2



No immediate change from the existing environmental condition is expected in regard to age-class distribution unless a large disturbance, such as a wildfire, occurs.

- ***Direct Effects of Action Alternatives B and C to Covertypes and Age Classes***

Mixed-conifer and other covertypes would change following harvesting, site preparation, and tree-planting activities, depending on the action alternative implemented.

The objective of the harvest prescriptions would be to remove lodgepole pine and shade-tolerant species (subalpine fir, grand fir, Engelmann spruce, western red cedar). For stands that would be harvested using the seedtree method, planting would promote the desired species (western larch, ponderosa pine, western white pine). Seedtrees left in the units would also be a desired species and would supply a seed source for natural regeneration.

TABLE C-1 - DIRECT EFFECTS TO COVERTYPE ACREAGES BY ACTION ALTERNATIVES B AND C shows the number of acres to be treated with each prescription and the resulting change in covertypes for each action alternative.

Seedtree harvesting would change stands from their existing age class to the 0-to-39-year age class. Older age classes would be reduced by 270 acres under Action Alternative B and 233 acres under Action Alternative C. By the intensity of thinning and objectives of the stand prescription, the older age class would be reduced by 358 acres under both action alternatives. *FIGURE C-2* - shows how acres would be redistributed in each age class. Other harvest methods, such as individual-tree selection, group selection, sanitation, and shelterwood, would not change age classes because treatments would concentrate on shade-tolerant younger trees and dead and dying trees. Age classes may also be affected due to the mortality of older Douglas-fir. Following harvesting activities, units would be examined to reestablish an average age for the stand. The majority of the older, mature trees that would be retained would either maintain the current stand age class or increase or decrease the stand age class, depending on the type of harvest selected.

TABLE C-2 - DIRECT EFFECTS TO AGE CLASSES BY ACTION ALTERNATIVES B AND C shows the number of acres to be treated and the resulting change in age class for each action alternative.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

Over time, natural forest succession and fire suppression would reduce the variability of age classes and covertypes on the landscape as stands age.

- ***Indirect Effects of Action Alternatives B and C to Covertypes and Age Classes***

Both action alternatives apply a variety of silvicultural treatments to stands across the project area. The types of treatments include: commercial thinning, group selection, sanitation, seedtree, individual-tree selection, and shelterwood.

Across the project area, the forest would contain a mosaic of structures to include single-storied, two-storied, and multistoried conditions. The structure changes through harvesting would emulate the type of fire regime associated with the covertype. Fire-regime simulations would range from stand replacing to mixed severity with flare-ups to light underburns. The fire regime implemented would

TABLE C-1 - DIRECT EFFECTS TO COVERTYPE ACREAGES BY ACTION ALTERNATIVES B AND C

COVERTYPE	ACRES HARVESTED BY PRESCRIPTION AND THE RESULTING CHANGE IN COVERTYPES			
	ACTION ALTERNATIVE B		ACTION ALTERNATIVE C	
	ACRES	CHANGE	ACRES	CHANGE
Subalpine fir	-0-	-0-	-0-	-0-
Douglas-fir	26 47 -34	Thin, but stays DF Regeneration, but stays DF Thin to PP	15 9	Thin, but stays DF Regeneration, but stays DF
Hardwoods	-0-	-0-	-0-	-0-
Lodgepole pine	-12 -8	Regeneration to WWP Thin to WL/DF	-12 -8	Regeneration to WWP Thin to WL/DF
Ponderosa pine	11 525 -19 +34 +112	Regeneration, but stays PP Thin, but stays PP Thin to WWP Change from DF Change from WL/DF	11 308 +32 +76	Regeneration, but stays PP Thin, but stays PP Add from MC Add from WL/DF
Mixed conifer	-45 -56 -11 -78 -1,018 92	Regeneration to WWP Thin to PP Thin to DF Regeneration to WL/DF Thin to WL/DF Thin, but stays MC	46 -32 -124 -941 -45	Thin, but stays MC Thin to PP Regeneration to WL/DF Thin to WL/DF Regeneration to WWP
Western larch/ Douglas-fir	-14 -112 77 259 +1,096 +8	Thin to WWP Thin to PP Regeneration, but stays WL/DF Thin, but stays WL/DF Change from MC Change from LPP	+8 +1,065 -76 77 161	Change from LPP Change from MC Thin to PP Regeneration, but stays WL/DF Thin, but stays WL/DF
Western white pine	+12 +19 +45 +14	Change from LPP Change from PP Change from MC Change from WL/DF	+12 +45	Change from LPP Change from MC

DF - Douglas-fir LPP - Lodgepole pine PP - Ponderosa pine MC - Mixed conifer WL - Western larch WWP - Western white pine SAF - Subalpine fir

TABLE C-2 - DIRECT EFFECTS TO AGE CLASSES BY ACTION ALTERNATIVES B AND C

ACTION ALTERNATIVE		AGE CLASS			
		0 TO 39 YEARS OLD	40 TO 99 YEARS OLD	100 TO 149 YEARS OLD*	150+ YEARS
B	Acres	+270	-90	-52	-128
	Method	Regeneration harvest			
	Acres			+358	-358
	Method	Thinning			
C	Acres	+233	-91	-52	-90
	Method	Regeneration harvest			
	Acres			+358	-358
	Method	Thinning			

* *Lodgepole pine is 100 to 139 years old*

correspond to the fire groups mentioned under *EXISTING VEGETATION*.

A seedtree harvest would be applied to 270 acres under Action Alternative B and 233 acres under Action Alternative C. This prescription emulates a stand-replacement fire because the largest share of trees would be harvested (killed). Some fire effects would be applied when slash is piled and burned due to the removal of fuel from the stand. Most regeneration would be western larch, Douglas-fir, ponderosa pine, and western white pine, which is similar to what would be expected following a fire. The number of snags retained represents the number of snags expected in undisturbed stands of similar age and covertype. The seedtrees would be the larger, fire-tolerant western larch, Douglas-fir, and ponderosa pine that tend to resist burning.

A commercial thinning treatment would be applied to 1,355 acres under Action Alternative B and 1,216 acres under Action Alternative C. This prescription emulates the effects of low-intensity fires with flare-ups that are common in the mixed-severity fire regime. Following harvesting and the retention of approximately 100 trees per acre, the canopy closure would range from 30 to 40 percent. Ponderosa pine stands may be thinned to a range of 20 to 30 percent to provide adequate openings for regeneration. The species retained would consist of the appropriate type for that area according to historical data. Regeneration would consist of western larch, Douglas-fir, and other species that are more shade tolerant.

Group-selection treatment methods would be applied to 207 acres under Action Alternative B. The intent of this prescription would be to remove dead and dying trees that have been affected by insects and diseases. Shade-tolerant species within the treatment area may also be removed. Areas of the stand would be treated, creating .5- to 2-acre openings in the canopy to benefit ponderosa pine establishment. Species retention would focus on ponderosa pine, western larch, and Douglas-fir. For the most part, regeneration would be allowed to occur naturally, but some ponderosa pine may be planted.

Other treatment types for both action alternatives are individual-tree selection and sanitation treatments. Action Alternative B would treat 487 acres with an individual-tree selection treatment and 82 acres with a sanitation treatment; Action Alternative C would treat 337 acres with an individual-tree selection treatment and 37 acres with a sanitation treatment. Harvesting would concentrate on the insect-infested and disease-infected trees or those at high risk, along with the shade-tolerant species (grand fir, subalpine fir, Engelmann spruce, etc). Ponderosa pine stands would focus on the removal of Douglas-fir and insect-and disease-affected trees. Another objective of the treatment would be to provide optimal growing conditions to the remaining trees. The sanitation treatment would concentrate specifically on removing dead, dying, and at-risk trees. Some of these stands have an abundance of Douglas-fir bark beetle and associated mortality.

Under both action alternatives a shelterwood treatment would be applied to approximately 43 acres along the highway corridor. This treatment would concentrate on understory species that are more shade tolerant and less desirable for the covertype. This

prescription emulates the effects of a low-intensity fire within the understory that generally does not reach overstory trees. Regeneration would be allowed to occur naturally within these stands.

Cumulative Effects

- ***Cumulative Effects to Covertypes***

The cumulative effects of Small Squeezer, Small Squeezer II, and South Wood timber sales have increased the amount of the western larch/Douglas-fir covertype on Swan River State Forest. This was done by removing shade-tolerant tree species from the mixed-conifer covertype. Proposed alternatives would further increase the amount of the western larch/Douglas-fir covertype by favoring Douglas-fir and western larch to leave. Treatments proposed in the action alternatives would also increase ponderosa pine and western white pine where appropriate. Treatments favoring seral covertypes would result in a corresponding reduction of the mixed-conifer covertype across the forest. *TABLE C-3 - CUMULATIVE EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVE* gives the anticipated cumulative effects of the Small Squeezer, Small Squeezer II, and South Wood timber sales, together with each proposed alternative, using the Swan River State Forest SLI database for baseline data. The table shows total acres remaining in each covertype with each action alternative's treatments and the net acres that would change covertype classification due to a treatment. Individual changes in acres by covertype are shown in *TABLE C-1 - DIRECT EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVE.*

- ***Cumulative Effects to Age Classes***

Natural stand development, past timber sales, and wildfires have created the current age-class representations in this area. Future sales would likely continue to be planned with the potential

TABLE C-3 - CUMULATIVE EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVE

COVERTYPE	ACRES AS ASSESSED BY SWAN RIVER STATE FOREST SLI DATABASE	CUMULATIVE ACRES ASSESSED WITH SMALL SQUEEZER, SMALL SQUEEZER II, AND SOUTH WOOD TIMBER SALES (ALSO REPRESENTS NO-ACTION ALTERNATIVE A)	CUMULATIVE ACRES (NET CHANGE IN ACRES) ACTION ALTERNATIVES	
			B	C
Subalpine fir	3,446	3,446	3,446 (0)	3,446 (0)
Douglas-fir	480	480	446 (-34)	480 (0)
Hardwoods	21	21	21 (0)	21 (0)
Lodgepole pine	2,315	2,195	2,175 (-20)	2,175 (-20)
Ponderosa pine	2,411	2,411	2,538 (+127)	2,519 (+108)
Mixed conifer	17,331	17,274	16,066 (-1208)	16,132 (-1142)
Western larch/ Douglas-fir	7,746	7,923	8,901 (+978)	8,920 (+997)
Western white pine	3,769	3,769	3,859 (+90)	3,826 (+57)

to modify age-class distribution within stands. Any changes in age classes would be reevaluated during scheduled SLI updates.

The tables reflect data from the Swan River State Forest SLI database that was updated in August 2001. Some ongoing timber sales are not included in this database; therefore, cumulative effects from the Small Squeezer, Small Squeezer II, and South Wood timber sales will be added in this section. The effects to age classes and acreages are taken from several sources, including the appropriate EAs/EISs, timber sale contracts, and visual reviews of the harvested areas. *TABLE C-4 - CUMULATIVE EFFECTS TO AGE CLASSES BY ALTERNATIVE* compares cumulative effects by alternative against the Swan River State Forest baseline data. Effects to old growth are discussed separately in the *OLD-GROWTH* section of this appendix (old-growth stands are included in the acres of stands over 150 years old).

Plum Creek Timber Company is managing their lands with various harvest practices. A higher percentage of acres in younger age classes of seral species are replacing the older stands that have occupied these sites in the past; this is expected to continue. The average age of forest stands would decrease in the general vicinity of the project area.

USFS lands in and around the project area have not been actively managed for many years. There is a large percentage of acres in the sapling- to pole-size age class in the project area (Section 17, T23N, R17W). The majority of USFS lands adjacent to the project area is mature timber with a small percentage of pole-sized timber. The average age of these forested stands will continue to increase in the general vicinity of the project area.

CANOPY COVERAGE

- ***Existing Condition/Direct Effects of No-Action Alternative A***

The combination of overstory and understory tree canopy averages 70 percent in the existing stands.

TABLE C-4 - CUMULATIVE EFFECTS TO AGE CLASSES BY ALTERNATIVE

ALTERNATIVE	CUMULATIVE ACRES IN SWAN RIVER STATE FOREST BY AGE CLASS (PERCENT OF ACRES IN SWAN RIVER STATE FOREST) [CHANGE IN ACRES]			
	0 TO 39 YEARS OLD	40 TO 99 YEARS OLD	100 TO 149 YEARS OLD*	150+ YEARS
Area as assessed by Swan River State Forest SLI database	7,777 (20.2)	6,672 (17.3)	6,783 (17.6)	17,316 (44.9)
Cumulative area with additional projects assessed (also represents No-Action Alternative A)	7,917 (20.5) [+140]	6,604 (17.1) [-68]	6,711 (17.4) [-72]	17,316 (44.9) [0]
Cumulative area in acres as assessed with Action Alternative B	8,187 (21.2) [+270]	6,514 (16.9) [-90]	6,659 (17.3) [-52]	17,188 (44.6) [-128]
Cumulative area in acres as assessed with Action Alternative C	8,150 (21.1) [+233]	6,515 (16.9) [-91]	6,659 (17.3) [-52]	17,224 (44.7) [-90]
*Lodgepole pine is 100 to 139 years old				

No-Action Alternative A would not change the canopy coverage in the short term. Over time, natural disturbances would cause mortality to individual and groups of trees, which would result in variable changes to canopy coverage as trees die and are replaced.

- ***Direct Effects of Action Alternatives B and C to Canopy Coverage***

The canopy cover following logging would affect the tree growth of residual trees and understory by allowing more light and moisture for remaining vegetation, as well as the success and species of regeneration. Following harvesting, the residual-tree canopy cover would vary by alternative and the prescription applied. For this analysis, the residual canopy cover includes all tree canopies remaining after harvesting, either merchantable or submerchantable.

In areas where seedtree harvesting would occur, the canopy coverage would decrease from 70 percent to 5 to 20 percent. In the 2 stands of shelterwood harvesting, the canopy would be decreased from 70 percent to 35 percent. In areas where selective harvesting would occur, the canopy coverage would decrease from 70 percent to 25-40 percent. In areas of commercial thinning, the canopy coverage would decrease from 70 percent to 25 to 55 percent. In areas where sanitation-type treatments would be used, the residual canopy coverage would be variable, depending on the amount of dead, dying, and at-risk trees within the stand. After harvesting, canopy coverage would be approximately 25 to 50 percent. One stand would have a group-selection-type treatment. The canopy coverage would be affected only in the group-harvest areas, which would be approximately 50 percent of the overall stand. Canopy coverage in these group-harvest areas would be reduced to 5 to 10 percent. *TABLE C-5 – DIRECT EFFECTS TO CANOPY COVERAGE BY ALTERNATIVE* shows the percent of canopy coverage by acres before and following harvesting for both alternatives.

- ***Indirect Effects of No-Action Alternative A to Canopy Coverage***

No indirect effects are expected.

- ***Indirect Effects of Action Alternatives B and C to Canopy Coverage***

Over time, canopy cover would increase in areas of seedtree and shelterwood harvests as regeneration replaces the cut trees. Ten to 15 years would be needed to develop up to 70 percent canopy cover in 10- to 15-foot-tall trees. Similar results would be expected in group-selection harvest areas.

In selective harvest, commercial thin, and sanitation harvest areas, residual canopy cover would increase over time. The increase is estimated at 10 to 15 percent in 10 years. In areas with a reduction to 40 percent, a return to 70 percent coverage would take approximately 20-30 years.

TABLE C-5- DIRECT EFFECTS TO CANOPY COVERAGE BY ALTERNATIVE

ALTERNATIVE	BEFORE HARVESTING (NO ACTION) 70+ PERCENT	RANGE OF ACRES IN CANOPY COVERAGE AFTER HARVESTING			
		SEEDTREE 5 TO 20 PERCENT	COMMERCIAL THIN SANITATION 25 TO 40 PERCENT	COMMERCIAL THIN SANITATION 45 TO 60 PERCENT	SELECTIVE 65+ PERCENT
B	2,444	270	1,071	905	198
C	1,866	233	954	565	114

FRAGMENTATION

- ***Existing Condition/Effects of No-Action Alternative A***

Historically, forest fires burning with various frequencies and intensities created the patterns and edges associated with forest patch size and shape. This resulted in a patchwork of various age classes of forests and a variety of sizes and shapes of forest stands. Since the advent of fire suppression and logging activities, the primary agent of patch development has been forest management and human developments. Intense fires during severe seasons still influence patch development, but the frequency of low-intensity fires and ignition sources for large fires is greatly reduced.

Swan River State Forest and adjoining properties display this pattern of fire-generated patches overlain by human-generated patches of logging units and land clearing. Past logging units often were designed in regular geometric patterns, usually ranging from 20 to 100 acres. When viewed from above, these patches created an unnatural-looking mosaic across the landscape. These past harvest units have been characterized as an unnatural "fragmentation" of the normal forest condition; however, the natural stand boundaries show that past landscapes were highly variable and fragmented by fire and other influences. More recent harvests on neighboring ownerships have followed property boundaries, making a checkerboard pattern of 300- to 640-acre patches. Past harvest openings on these ownerships have utilized both even-aged regeneration harvesting (seedtree and clearcutting) and uneven-aged (individual-tree selection and group selection) harvesting.

The Swan River State Forest SLI database shows that timber stands are delineated along natural and human-generated boundaries. The natural boundaries fall along edges of moisture regimes, age classes, soil types, topographic features, and fire influences that created visible differences in timber-stand characteristics. The human-generated boundaries follow property boundaries, natural boundaries, and past harvest areas. The stand size is variable, depending on location, and ranges from 5 to several hundred acres. In the project area, stand sizes reflect both past harvesting and large fires that burned prior to European settlement.

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of Action Alternatives B and C to Fragmentation***

Where seedtree and shelterwood harvesting is proposed, the harvest units would mainly follow the stand boundaries delineated in the SLI database. The primary effect would be to create new, younger-aged patches of the existing stand size, with irregular boundaries.

Where other treatment types would be utilized, the patch sizes or shapes would not change except in the group-selection units, which would create .5- to 2-acre openings. The openings would be similar to flare-up areas in low-intensity fires.

Indirect Effects

- ***Indirect Effects of Action Alternatives B and C to Fragmentation***

Some seedtree and shelterwood harvest units are adjacent to past harvest areas and other proposed harvest units and would result in an enlargement of the younger age-class patches and a blending of

the geometric shape of the old units.

In units where other treatment types would be utilized, some of the harvesting may tend to reduce the differences between adjacent stands and actually increase the patch size across similar stands.

Cumulative Effects

- ***Cumulative Effects of Action Alternatives B and C to Fragmentation***

Where seedtree and shelterwood units are proposed, there would be an overall increase in younger age-class patches and a decrease in older age classes, moving the forest towards historic conditions. See the age-class discussion for acres that would change by alternative. Small Squeezer, Small Squeezer II, and South Wood timber sales have added to the fragmentation of the forest. The stands that primarily contributed to the fragmentation are the seedtree units. Units that involve thinning treatments did not provide harsh breaks in the canopy, but a reduced canopy cover. The aerial view shows the differences or fragmentation from one unit to the other. Fragmentation of stands is evident from the point of stand density, but not from the point of age class. Thinning can maintain a certain age class and, therefore, the landscape has larger patches and less fragmenting.

INSECTS AND DISEASE

BACKGROUND

Identifying damaging or potentially damaging insects and diseases is an important part of designing project-level timber sales. Various types of forest structure and composition are more vulnerable to certain insects, diseases, windthrow, and wildfire than others (*Byler and Hagle, 2000*). Identifying stands with the most vulnerable structure and composition and developing management plans for them can help alleviate future problems that may interfere with long-term forest management objectives.

ANALYSIS METHODS

Swan River State Forest is observed from the air annually and insect and disease problems are mapped. DNRC and USFS provide a report of the aerial reconnaissance with updates on insect and disease trends across the Inland Northwest. In addition to investigating these reports, DNRC personnel also include their own observations of additional forest health conditions as they occur on Swan River State Forest.

The focus on the Goat Squeezer Timber Sale Project will include:

- the effects of insects and diseases,
- existing conditions in relation to the project or harvest areas,
- management recommendations, and
- potential sawlog-value losses to the trusts.

ANALYSIS AREA

The analysis area is primarily within the Goat Squeezer Timber Sale Project area.

Major forest diseases and insects currently affecting forest productivity, structure, and composition within the Goat Squeezer project area:

- Armillaria root disease (*Armillaria ostoyae)*
- White pine blister rust (*Cronartium ribicola)*
- Larch dwarf mistletoe (*Arceuthobium laricis)*
- Indian paint fungus (*Echinodontium tinctorium)*
- Red-brown butt rot (*Phaeolus schweinitzii)*
- Douglas-fir bark beetle (*Dendroctonus pseudotsugae)*
- Fir engraver (*Scolytus ventralis)*

Other insects and diseases are

present in the project area, but are not recognized as having important management implications.

➢ *Armillaria Root Disease*

Armillaria root disease, caused by the fungus *Armillaria ostoyae*, is a damaging pathogen of conifers in western North America. This fungus commonly invades stressed trees or trees infected with other root-rot-type infections. *Armillaria ostoyae* spreads mainly via root contacts, but also through a short-distance growth of rhizomorphs through soil (*Redfern and Filip 1992*). Viable *Armillaria ostoyae* inoculum can persist in below-ground portions of stumps and large roots for several decades (*Roth et al. 1980*). The fungus colonizes the root collar, kills the cambium, and eventually girdles the tree, causing mortality. Conifers exhibit variation both in response to infection by *Armillaria ostoyae* (*Robinson and Morrison 2001*) and susceptibility to mortality (*Hadfield et al. 1986*). Species susceptibility ratings for Armillaria root disease in western Montana are as follows:

- severely damaged: Douglas-fir, grand fir, and subalpine fir,
- moderately damaged: ponderosa pine, lodgepole pine, and western white pine, and
- seldom damaged: western larch and western red cedar.

Conifers should be considered equally susceptible to Armillaria root disease before age 15 to 20 (*Hodfield et al. 1986; Morrison et al. 1991*).

Root infection by *Armillaria ostoyae* may result in increased levels of ethanol within the host tree, as shown with other root-infecting diseases (*Kelsey and Joseph 1998*). Ethanol in combination with host resins, commonly present on *Armillaria ostoyae*-infected roots as a response to fungal infection (*Hadfield et al. 1986*), can act synergistically as a kairomone for bark and root-feeding beetles (*Schroeder and Lindelow 1989*), thereby increasing the likelihood that *Armillaria ostoyae*-infected trees are located and attacked by species of bark beetles (*Goheen and Hansen 1993*). Disease centers range in size from that occupied by a single tree to tens of acres, in shapes from circular to highly irregular, in resolution from distinct to diffuse, and in incidence from a few to many centers per unit area (*Morrison et al 1991*).

Stand management in these instances should emphasize maintenance of seral species, such as western larch and ponderosa pine, in thinnings, selection harvests, and seedtree cuts, and removal of the susceptible mid-to late-serals such as grand fir and Douglas-fir (*Morrison and Pellow 1994; Morrison and Mallet 1996; Morrison et al. 1991*). This occurs because latent infections of *Armillaria ostoyae* may be present on the roots of many of the nonsymptomatic trees between active root disease centers (*Morrison et al. 2000*). Western larch, in particular, shows increasing resistance to Armillaria past the age of 15 (*Morrison et al. 1991*) and is colonized by root lesions less frequently than comparably aged Douglas-fir (*Robinson and Morrson 2001*).

Silvicultural approaches that emphasize seral species are recommended even for stands with low levels of Armillaria root disease (*Filip and Goheen 1984; Morrison and Mallett 1996*). Selective cutting in such stands is the least favorable option as it will likely result in an increased inoculum load, in the form of *Armillaria ostoyae*-

colonized root systems, dispersed among the remaining crop trees (*Morrison et al. 2001, Morrison and Mallett 1996*). In mixed-species stands composed of serals and shade-tolerant, late-successional species, the seral species should be favored during intermediate stand entries in order to limit the root-to-root pathways between more readily damaged species. In stands where root rot is present, natural regeneration will be utilized because planted trees seldom show the level of resistance displayed by naturally regenerated trees (*Morrison et al. 2000; Ruzzo et al. 1995*). In areas where western larch is not present to provide a seed source, planting would occur.

Extensive areas of Armillaria root disease have been identified in Sections 10, 16, 22, and 26, T23N, R17W, and Section 32, T24N, R17W of the project area (*Brennan Ferguson, DNRC Contract Pathologist, personal observations*).

- ***White pine blister rust***

White pine blister rust, caused by the introduced pathogen *Cronartium ribicola*, is the primary cause for the reduction of the western white pine in the forest covertypes in which it historically occurred across the project area. Western white pine of all ages and sizes can be infected and killed by white pine blister rust. The western white pine that remains alive on Swan River State Forest do so for 1 of 2 reasons: either they possess natural genetic resistance to the rust or they are susceptible to the rust and have not yet become infected. Western white pine are also very susceptible to attack by the mountain pine beetle, even when they exist as relatively isolated individuals in stands of mixed conifer.

Western white pine produces high-value sawlogs averaging $446 per MBF (*University of Montana 2001*). White pine harvested from the Stillwater State Forest's Werner/Taylor project area and the 1999 salvage permit averaged $300 per MBF. Trees infected by white pine blister rust often have dead tops that reduce sawlog volume and value. This species is also highly favored by firewood cutters.

Management and restoration recommendations for western white pine emphasize planting rust-resistant western white pine seedlings, and maintaining white pine genetic diversity (*Fins et al. 2001*).

Monitoring of rust levels should be performed at various times in the life of a stand, and bole pruning to reduce the chances of blister rust infections may be required if rust levels are high when the trees are still young. Retention of various numbers of natural, mature, seed-bearing western white pine is encouraged in order to maintain genetic diversity of the species (*Schwandt and Zack 1996*).

- ***Western larch dwarf mistletoe***

Western larch dwarf mistletoe, caused by *Arceuthobium laricis*, is considered the most important disease of western larch in the Inland West (*Beatty et al. 1997*). Dwarf mistletoes are parasitic plants that obtain moisture and nutrients from their hosts, resulting in a reduction in tree vigor, growth, and the quantity and quality of western larch seed production. Dwarf mistletoe spreads when seeds from the mistletoe plants are forcibly dispersed in the fall; seeds that land on susceptible host plants germinate the following spring and infect the host tissues. Dwarf mistletoe infections eventually

cause branches to form dense clumps of foliage and twigs, also know as 'witches brooms'. In western larch these brooms are prone to breaking off under snow load, often leading to the decline of the tree as more and more branches are lost. In this case mature trees can die due to mistletoe or attack by the western larch borer. The seed-to-seed life cycle of dwarf mistletoe species are generally 4 to 6 years in length. Spread and intensification of dwarf mistletoe is at its worst when an infected overstory exists over an understory of the same tree species.

Western larch dwarf mistletoe is patchily distributed in the overstory western larch across the project area; infection levels range from light to heavy (*Brennan Ferguson, DNRC Contract Forest Pathologist, personal observations*). Seedtree regeneration or shelterwood treatments can still be carried out in stands that have dwarf mistletoe infections in the overstory, but tree selection in such instances needs to discriminate against the most heavily dwarf mistletoe-infected western larch and leave non- or lightly-infected trees (*Beatty et al. 1997*).

To prevent damaging levels of dwarf mistletoe from developing in larch regeneration, the infected overstory trees should be removed or killed once larch regeneration is established and before the regeneration is either 7 years old or 3.3 feet in height, whichever comes first (*Mathiasen 1998*). Firewood gatherers are aggressively salvaging dead western larch where road access is available.

➢ ***Indian Paint Fungus***

Indian paint fungus, so called because Native Americans used the fruiting body in making pigment, is a true heartrot that commonly infects true firs and hemlocks. It is the predominant cause of heartrot and volume losses in these species in western North America (*Hansen and Lewis 1997*). True heartrots are generally confined to the heartwood of trees, consistently produce fruiting bodies or conks on the stems of living trees, and do not rely on mechanical wounding as their principal infection court (*Etheridge and Hunt 1978*). Large diameter grand fir with decay caused by Indian paint fungus are important habitat, both while standing and down, for various species of cavity-nesting birds and mammals (*Bull et al. 1997*).

Trees become infected by *Echinodontium tinctorium* spores via small branchlet stubs. The spores become overgrown by the tree and can lay dormant for decades (*Maloy 1991*). Heaviest infections tend to occur in advanced regeneration growing under an infected overstory. Growth of the fungus is reactivated when the tree is wounded, either naturally or mechanically, develops frost cracks, or is otherwise physiologically altered. The fungus causes extensive decay of the heartwood and, over time, these trees become much more susceptible to stem breakage. A rule-of-thumb is that one conk on the stem of a tree indicates approximately 16 feet of extensive decay in either direction, while several conks on the stem of a tree indicate that the tree is a cull. In the Goat Squeezer project area, Indian paint fungus is well distributed on grand and subalpine firs. Stand-exam and reconnaissance surveys reveal that

15 to 20 percent of these species are infected. To reduce losses from this pathogen, management recommendations include:

- keeping rotations of susceptible species under 150 years unless amount of infection is light;
- early thinnings;
- selecting the most vigorous, non-wounded trees for residuals; and
- minimizing wounding of susceptible hosts when thinning, prescribed burning, or performing any silvicultural treatments (*Filip et al. 1983*).

➢ ***Red-brown butt rot***

Red-brown butt rot is caused by the root-infecting pathogen *Phaeolus schweinitzii*. Any conifer can be a host, but it is found primarily in Douglas-fir. Instead of affecting trees in groups as do root diseases such as Armillaria, red-brown butt rot tends to affect trees on an individual basis (*Hansen and Lewis 1997*). The fungus can, however, cross from tree to tree at root grafts and contacts. Most damage occurs in stands more than 80 years of age. The pathogen infects via small roots and causes a decay in the interior of roots. This decay extends into the butt log an average of about 8 feet, making such trees highly susceptible to stem collapse and windthrow. Since such trees are most often green when windthrown, they provide prime habitat for bark beetle brood. Management options are limited. Rotations can be shortened to about 90 years in Douglas-fir to minimize loss due to decay, and less affected host species can be emphasized over Douglas-fir.

➢ ***Douglas-fir bark beetle***

The Douglas-fir bark beetle is currently active across Swan River State Forest. The project area has a moderate incidence of Douglas-fir bark beetle in the areas proposed for harvesting. In general, stands that are at highest risk to attack by the Douglas-fir bark beetle are those with:

- a stand basal area greater than 250 square feet,
- an average stand age greater than 120 years,
- an average Douglas-fir diameter over 14 inches, and
- stand composition greater than 50 percent Douglas-fir (*USDA Forest Service 1999*).

The Douglas-fir within most of the proposed harvest areas on the Goat Squeezer project area are at moderate risk of Douglas-fir bark beetle attack due to age and stocking levels. Low, or nonoutbreak, populations of Douglas-fir bark beetle tend to exist in fresh blowdown, fire-killed trees, or live trees within and around pockets of root disease (*Livingston 1999; Schmitz and Gibson 1996*). Management of the Douglas-fir bark beetle should concentrate on the removal of windthrown Douglas-fir and the salvage of newly attacked trees before adult beetles can emerge (*Livingston 1999; Schmitz and Gibson 1996*). Valuable Douglas-fir, those in and around campgrounds for example, that are considered to be at high risk of attack can be protected by use of the Douglas-fir bark beetle anti-aggregant pheromone 3-methylcyclohex-2-en-1-one (MCH) (*Ross et al. 2001*).

In 1999, numerous pockets of infestations were located within the analysis area. Each spring following the flight of the beetle, reconnaissance surveys were conducted by DNRC foresters to determine the extent of the infestations. It was estimated

that the beetle had caused heavy Douglas-fir mortality on approximately 2,500 acres. The Swan River State Forest timber permit program allowed for the salvage harvesting of approximately 2 MMBF of sawlogs in 1999, 600 thousand board feet (MBF) in 2000, and 500 MBF in 2001.

➤ ***Fir engraver***

The fir engraver, *Scolytus ventralis*, is currently damaging or killing many grand and subalpine firs in Swan Valley (*Steve Kohler, DNRC Forest Entomologist, personal communication*). This bark beetle is wide-ranging across the west, attacking primarily grand fir (Ferrell 1986). Nonoutbreak populations of fir engraver beetles are closely associated with trees affected by root disease or other localized factors that stress trees; they rarely attack vigorous grand fir (*Goheen and Hansen 1993*). However, when grand fir and other preferred hosts become stressed during periods of drought, the fir engraver can begin attacking otherwise healthy trees across the landscape and the association with root disease becomes less distinct (*Goheen and Hansen 1993*). Management of fir engraver is problematic. In general, silvicultural practices that promote the vigor of grand fir stands, thinning for example, will also reduce the chances of extensive damage during periods of drought *(Ferrell 1986)*. Management practices aimed at reducing the impact of root disease will also help lessen the long-term impacts of the fir engraver. Such practices include the promotion of less root-disease-susceptible species such as western larch, western white pine, and ponderosa pine in areas with extensive root disease.

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Insects and Diseases***

  Sawlog volume would continue to be lost from the project area due to insect and disease effects, especially from Douglas-fir bark beetles and Armillaria root disease in inaccessible stands with large trees. Salvage logging would continue where stands are accessible without building roads.

  If No-Action Alternative A were implemented, no acres of western white pine or ponderosa pine covertypes would be regenerated.

- ***Direct Effects of Action Alternatives B and C to Insects and Diseases***

  For all treatments except seedtree, the direct effect would be the removal of trees affected by insects and diseases and the salvage of recently dead trees. Snags meeting DNRC density guidelines would be left. Due to the removal of the low-vigor and diseased trees, the average health of the stand would be increased.

  Where seedtree and shelterwood harvest treatments are applied, the direct affect would be to remove trees affected by insects and diseases, trees with reduced growth rates due to old age, as well as shade-tolerant trees that did not correspond with the appropriate covertype (i.e. all merchantable trees with the exception of seedtrees). Seedtrees would be left scattered to provide a seed source for natural regeneration.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Insects and Diseases***

  School trusts may lose long-term revenue due to:

  - the slowly increasing mortality

rates and increased sawlog defect that are caused by a slow increase in incidence of the variety of pathogens aforementioned;

- the reduced growth rates as old-growth stands continue to age and defects increase; and
- not regenerating high-valued species, such as western white pine.

- ***Indirect Effects of Action Alternatives B and C to Insects and Diseases***

  Where commercial thinning, individual-tree selection, and shelterwood treatments are applied, the indirect effect would be increased growth rates on the remaining trees due to the availability of light and moisture. The improved growth rates naturally make the trees more resistant to pathogens and insect attacks.

  Where seedtree harvests are applied, rust-resistant western white pine, western larch, or ponderosa pine would be planted. If successful at resisting the white pine blister rust, these seedlings would replace a missing component of the stands. If ponderosa pine became well established, a diminishing component would be enhanced.

  Where group-selection treatments are applied, small openings would be created in the stand. The removed trees would consist of those that have insect or disease problems, primarily Douglas-fir bark beetle, which could improve the overall health of the stand and reduce the possibility of spread to other stands.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Insects and Diseases***

  Under this alternative no harvesting of dead, dying, or high risk trees would occur. Some salvage of insect-infested and disease-infected trees would occur, but at a slower and less effective rate. Forest stands would maintain dense stocking levels, which contributes to the spread of insects, diseases, and fuel loading which could lead to catastrophic fires, unnatural forest structures, and overall poor health of the stand. The current forest conditions would continue.

- ***Cumulative Effects of Action Alternatives B and C to Insects and Diseases***

  In general, timber-management activities on Swan River State Forest have implemented prescriptions to reduce losses and recover mortality due to stem rots, Douglas-fir bark beetles and mountain pine beetles, white pine blister rust, and dwarf mistletoe. Where stand-replacing or regeneration prescriptions have been applied, the stands have been replaced with younger, less-diseased trees. Thinning treatments have further reduced the percentage of infected/ infested trees. The cumulative extent of these treatments is represented by *TABLE C-4 - CUMULATIVE EFFECTS TO AGE CLASSES BY ALTERNATIVE*, where the 0-to-39-year age class is primarily a result of silvicultural treatments.

  TABLE C-3 - CUMULATIVE EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVE gives an estimate of the cumulative effects of thinning treatments. Where covertypes have changed, the change is either due to regeneration treatments or thinning to remove low-vigor trees. Thinning lowers the incidence of pathogens and reduces the risk of stand-replacement fires.

  The DNRC salvage program has removed some beetle-infested trees that were outside of the project

area prior to the spring flight of the Douglas-fir bark beetle.

FIRE EFFECTS

HISTORY

Swan River State Forest

The fire regimes across Swan River State Forest are variable. The forest, as a whole, has a mosaic pattern that was developed from different fire frequencies and intensities. There are areas of frequent fire, which produced a Douglas-fir, western larch, and ponderosa pine covertype, with a lodgepole pine and western white pine representation. As the fire frequencies become longer, the more shade-tolerant species (grand fir, subalpine fir, Engelmann spruce, western hemlock, western red cedar) begin to develop. The higher elevations within the forest have longer fire frequencies and the stands are multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open and single storied, occasionally two storied. As fire suppression began, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Once open, ponderosa-pine-dominated stands now have a thick understory of Douglas-fir. Fires that do occur are generally kept small, and natural fire effects are limited. If a larger-scale fire were to get started, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

PROJECT AREA

The Goat Squeezer Project area is primarily represented by 3 different fire regimes that are classified as fire groups: Fire Group 11, Fire Group 6, and Fire Group 9 (listed in descending order of representation). There are other fire groups associated within the project area, but, due to their minor representation, will not be addressed further in this document. The project file at the Swan River State Forest office will contain the information of the other fire groups.

Fires burned in the project area at intervals of 15 years to as long as 200 years. The various fire intervals and intensities created a mosaic in the forest across the project area. Management in the project area is attempting to represent fire patterns and intensities. The species represented in the project area has also been influenced by fire disturbances. Treatments would attempt to restore historic covertypes (western larch/Douglas fir, ponderosa pine, etc) where feasible and maintain these covertypes by future management activities.

HAZARDS AND RISKS IN THE PROJECT AREA

The hazards and risks associated with wildfire include a potential loss of timber resources, effects to watersheds, and loss of property. The majority of timber stands being considered for harvesting are in the pole to mature age classes in stands that have not burned since pre-European settlement. Hazards in these areas are at near-natural levels, with moderate to high accumulations of downed and ladder fuels relative to the high tree-stocking levels. Some of the ponderosa pine stands have a dense understory of Douglas-fir, which can present a significant hazard due to density, structure, and the increased possibility of a low-intensity ground fire becoming a stand-replacing crown fire.

The continued encroachment of shade-tolerant trees, down woody-debris accumulations, and mortality increases the fire risks.

The old-growth stands in the vicinity are primarily relict stands that escaped the stand-replacing fires of the past. As the stands age and die from various pathogens, down dead fuels build up. In some stands an ingrowth of shade-tolerant trees provide ground and ladder fuels, making these stands more susceptible to burning than in the past, especially during drought conditions. Accessible stands have had salvage logging and firewood cutting, reducing the heavy down fuels in the area.

Another hazardous condition related to the start of fires in this area of Swan River State Forest is increased recreational use. This adds an ignition source that was not present in the past.

Forestland adjacent to the project area has a wide range of fuel loading. Much of the adjacent Plum Creek Timber Company ownership has been harvested in recent years; the resulting stands have a low wildfire risk due to light fuel loading.

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Fire Effects***

  The hazards of wildfires would not change substantially in the short term. With continued fuel accumulation from downed woody debris, the wildfire potential increases. Large-scale, stand-replacing fires may be the outcome.

- ***Direct Effects of Action Alternatives B and C to Fire Effects***

  Immediately following timber harvesting, the amount of fine, flashy fuels would increase. The hazard would be reduced by scattering slash, cutting limbs and tops to lay low to the ground to hasten decomposition, spot piling by machine in openings created by harvesting, and burning landing piles.

  Seedtree units may utilize broadcast burning to reduce fuels and help prepare seedbeds. Burning would consume fuels, which could return nutrients to the soil at a faster rate. Other stands may be piled and burned, along with all landing piles.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fire Effects***

  Eventually, due to the continuing accumulation of fine fuels, snags, ladder fuels, and dead-wood components, the risk of a stand-replacement fire would increase.

- ***Indirect Effects of Action Alternatives B and C to Fire Effects***

  The hazard of wildfires in these stands would be reduced because larger, more fire-resistant trees would be left at a wider spacing. Grand fir, some Douglas-fir, Engelmann spruce, and subalpine fir, which pose a higher crown-fire hazard because of their low-growing branches and combustible nature, would be removed. This would reduce the potential mortality from low- to moderate-intensity fires, but would not "fireproof" the stands from the high-intensity, stand-replacing fires brought on by drought and wind.

  Seedtree and shelterwood harvest treatments would cause wildfire hazards to be reduced to a very low level. Regeneration harvests where slash has been treated, but trees are still small, have proven to be fire resistant. Fire hazards would slowly increase over time as trees reach pole size and their crown density increases.

  Group-selection units would not necessarily affect the fire-hazard level other than in the treated areas. Untreated portions of the stand would remain at their

current levels for fire hazard, while the treated areas would see a reduced fire hazard. Pockets of dead and dying trees would be removed, which could reduce the chance for a flare-up or conflagration.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Fire Effects***

  Under this alternative, the risk of wildfire would continue to increase as a result of long-term fire suppression.

- ***Cumulative Effects of Action Alternatives B and C to Fire Effects***

  Fuel loadings would be reduced in stands that are treated, which would decrease wildfire risks in these specific areas.

OLD GROWTH

CURRENT SITUATION AND DISTRIBUTION OF OLD GROWTH

The Department is enjoined from harvesting in old-growth stands on timber sales that were named in Judge Sherlock's ruling. The Department is also enjoined from using the 1998 biodiversity guidance for developing new timber sale projects. Administrative rules have been developed for the DNRC's old-growth management, but have not been finalized.

DNRC defines old growth based on the number and size of large trees according to the minimums proposed by *Green et al., (1992)*. The SLI provides the data for labeling stands as old growth. At the project level, stands identified as old growth through the SLI are verified through additional field reconnaissance, including collection of plot-level data. *FIGURE C-3 - STANDS THAT MEET THE GREEN ET AL DEFINITION FOR OLD GROWTH* shows a representation of old-growth stands within the project area.

Several approaches to estimating historic, or naturally occurring old-growth amounts, have been explored. Previous efforts to estimate amounts of old growth that historically occupied the landscape in Swan Valley include:

- The *FNF Plan Amendment 21 (1998)* an estimated 29 percent of the Flathead basin was occupied by late seral age classes. This estimate was interpreted from a timber survey done in 1898 and 1899 by *H.G. Ayres*.
- *Lesica (1996)*, in an effort to use fire history to estimate the proportions of old-growth forests in Swan Valley, estimated that approximately 52 percent of the area was occupied by stands that were 180 years or older.
- Using covertype conditions and historical data from the 1930s, summarized by *Lozensky (1997)*, an estimated 29 percent of the forested acres on Swan River State Forest would have historic conditions occupied by old growth (*South Fork Lost Creek SEIS, 1998*)
- *Hart (1989)* indicated that approximately 48 percent of the area contained in the 1930s stand data for Seeley and Swan valleys had forests with a significant component of trees older than 200 years.

Estimates of the amount of naturally (historically) occurring old growth for Swan River State Forest range from 29 to 52 percent.

That amounts to 33.7 percent of the forested acres on the forest. Acreages may change as field surveys are completed and the SLI database is updated. *TABLE C-6 - CURRENT AND POSTHARVEST AMOUNTS OF OLD GROWTH BY COVERTYPE IN SWAN RIVER STATE FOREST* shows the amount of acres in old-growth status per covertype according to current SLI database information. The analysis also looks at the old-growth spatial arrangement, which is helpful for

FIGURE C-3 STANDS THAT MEET THE GREEN ET AL DEFINITION FOR OLD GROWTH

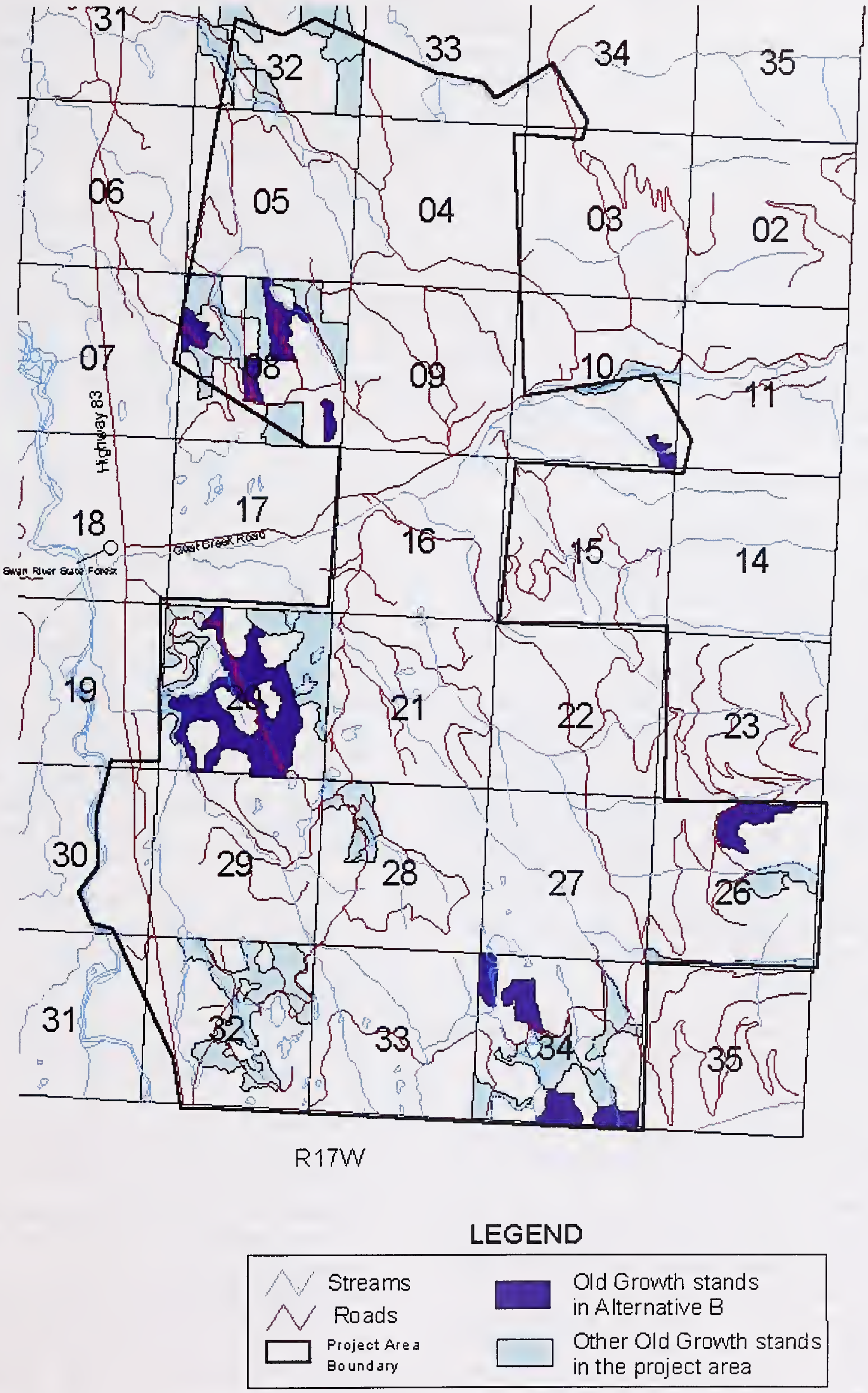


TABLE C-6 - CURRENT AND POSTHARVEST AMOUNTS OF OLD GROWTH BY COVERTYPE IN SWAN RIVER STATE FOREST

OLD-GROWTH TYPE	CURRENT OLD-GROWTH ACRES	POSTHARVEST OLD-GROWTH ACRES ACTION ALTERNATIVE B	POSTHARVEST OLD-GROWTH ACRES ACTION ALTERNATIVE C
Ponderosa pine	592	No change	No change
Douglas-fir	0	No change	No change
Western larch/ Douglas-fir	1,935	No change	No change
Lodgepole pine	0	No change	No change
Western white pine	1,927	No change	No change
Mixed conifer	7,059	No change	No change
Subalpine fir	1,113	No change	No change
Total	12,626	12,626	12,626

developing and refining alternatives on the project level and analyzing the effects of a proposed action.

ANALYSIS METHODS

DNRC uses criteria from *Green et al* to define old growth. The definition sets minimum thresholds for the number and size of large trees based on habitat type and covertype for labeling a stand as old growth. According to information in the SLI database, many stands have been identified as old growth. As part of the field reconnaissance for this project, stands labeled as old growth in the SLI database, or those in question, were field checked to verify that they met the *Green et al* definition.

OLD-GROWTH ATTRIBUTES IN THE GOAT SQUEEZER PROJECT AREA

Background

To address some problems associated with old-growth definitions, DNRC has developed an index of 'old growthedness'. For this analysis the index will be used to display changes to old-growth stands.

Methods

Attribute levels for old-growth stands on Swan River State Forest were assessed using the SLI database. This analysis displays changes to the acres of old growth and how attribute levels would be affected by each alternative.

FULL OLD-GROWTH INDEX (FOGI)

Description

The FOGI supplies the ability to apply a quantitative definition of old growth, but does not, in and of itself, propose one. The primary purpose of the index is to describe the status of old growth on DNRC lands and provide a link to naturally occurring amounts and conditions of old growth. The FOGI index is a means to measure old-growth characteristics based on a point system for physical attributes that are often associated with stands in the latter stages of development. Points (0 to 7) are given in the following categories:

- large live trees per acre,
- coarse woody debris,
- snags per acre,
- decadence,
- stand structure,
- volume per acre, and
- canopy cover.

The total amount of points for the stand will indicate whether the attributes are low, medium, or high.

TABLE C-7 - FOGI CLASSIFICATIONS BY COVERTYPES FOR SWAN RIVER STATE FOREST displays the FOGI classifications by covertype within the project area, followed by *TABLE C-8 - FOGI CLASSIFICATION WITHIN PROPOSED HARVEST AREAS* , which describes the FOGI classifications

TABLE C-7 - FOGI CLASSIFICATIONS BY COVERTYPES FOR SWAN RIVER STATE FOREST

COVER TYPE	ACRES OF LOW ATTRIBUTE LEVELS	ACRES OF MEDIUM ATTRIBUTE LEVELS	ACRES OF HIGH ATTRIBUTE LEVELS	TOTAL ACRES
Subalpine fir	69	362	682	1,113
Douglas-fir	-0-	-0-	-0-	-0-
Mixed conifer	15	1,933	5,110	7,059
Ponderosa pine	-0-	361	231	592
Western larch/ Douglas-fir	10	817	1,109	1,935
Western white pine	-0-	523	1,404	1,927
Totals	94	3,996	8,536	12,626

TABLE C-8 - FOGI CLASSIFICATION WITHIN PROPOSED HARVEST AREAS

SECTION NUMBER	STAND NUMBER	INCLUDED IN ALTERNATIVE	TOTAL OLD-GROWTH ACRES PROPOSED FOR HARVESTING	FOGI		
				INDEX NUMBER	COVERTYPE AND CLASSIFICATION	
8	9	B	19	13	Ponderosa pine	Medium
8	11	B	34	19	Western larch/ Douglas-fir	Medium
8	13	B	14	19	Western larch/ Douglas-fir	Medium
8	15	B	10	11	Western larch/ Douglas-fir	Low
10	20	B	10	19	Ponderosa pine	Medium
20	36	B	207 (Approximately 100 in group selection	21	Ponderosa pine	High
26	43	B	41	23	Western larch/ Douglas-fir	High
34	63	B	12	13	Western larch/ Douglas-fir	Medium
34	65	B	30	15	Western larch/ Douglas-fir	Medium
34	71	B	15	9	Mixed conifer	Low
34	72	B	26	15	Mixed conifer	Medium

for individual stands proposed for harvest in Action Alternative B.

See *TABLE C-9 - FOGI ATTRIBUTE CLASSIFICATION CHANGES UNDER ACTION ALTERNATIVE B* (next page) for the covertypes proposed for treatments, their current FOGI classification, the postharvest FOGI classification, and the preharvest and postharvest index numbers.

TABLE C-9 - FOGI ATTRIBUTE CLASSIFICATION CHANGES UNDER ACTION ALTERNATIVE B

STAND NUMBER	COVERTYPE	FOGI			
		PREHARVEST INDEX NUMBER	CURRENT FOGI CLASS	POSTHARVEST INDEX NUMBER	POSTHARVEST CLASSIFICATION
9	Ponderosa pine	13	medium	13	medium
11	Western larch/ Douglas-fir	19	medium	9	low
13	Western larch/ Douglas-fir	19	medium	12	medium
15	Western larch/ Douglas-fir	11	low	11	low
20	Ponderosa pine	19	medium	13	medium
36	Ponderosa pine	21	high	21	high
43	Western larch/ Douglas-fir	23	high	13	medium
63	Western larch/ Douglas-fir	13	medium	8	low
65	Western larch/ Douglas-fir	15	medium	13	medium
71	Mixed conifer	9	low	9	low
72	Mixed conifer	15	medium	12	medium

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Old Growth***

  The amount, character, and distribution of existing old-growth stands would remain the same within the project area for the short term. In the long term, existing old growth would continue to age and become more decadent. Some stands may drop out of the classification as old growth because Douglas-fir bark beetles are killing sufficient trees to reduce the number of large live trees below the minimum trees per acre described in *Green et al.*

- ***Direct Effects of Action Alternative B to Old Growth***

  The proposed harvest treatments for Action Alternative B would affect old growth on approximately 418 acres. Timber harvesting would be conducted in old-growth stands on 236 acres of the ponderosa pine covertype, 140 acres of the western larch/ Douglas-fir covertype and 41 acres of the mixed-conifer covertype. Old-growth stands would be harvested with individual-tree-selection, group-selection, sanitation, and commercial-thin treatments. The main objectives for entering these old-growth stands are to remove insect-infested and disease-infected trees, maintain the historical covertypes, and remove or reduce shade-tolerant species. Open ponderosa pine stands were once common in Swan Valley; DNRC's intent is to maintain current ponderosa pine stands and return other stands back to this species. All the stands proposed for harvesting would still be classified as old growth following harvesting.

  The primary effect to old-growth stands would be to reduce their FOGI attribute levels. The FOGI attributes that would be affected include:

  - The stocking level in commercial-thin, sanitation, and individual-tree-selection harvest treatments would be reduced overall. The stocking level in group-selection harvest treatments would only be lowered in the treated patches.

- Tree vigor would improve or remain at existing levels for the remaining trees within commercial-thin, sanitation, and individual-tree-selection treatments. The group-selection treatment would see no increase.

- The stand structure in commercial-thin, sanitation, and individual-tree-selection harvest treatments are currently multistoried and would be reduced to a 2- or 3-storied structure. The group-selection treatment would have .5- to 2-acre openings in the stand. The remaining areas of the stand would not be affected.

- Snags would be retained at a level of approximately 2 trees, 21 inches or greater, per acre (if there are no trees that large, the next largest trees would be retained) for all units involved.

- Slash from treatments would be piled and burned or otherwise treated on site, but 15 tons of coarse woody debris per acre would be retained. For the group-selection treatment, slash would be lopped and scattered; other areas would be whole-tree skidded, with slash piled and burned at the landing.

- Large live trees would be removed if they are dying from insect or disease attacks or to provide openings for ponderosa pine regeneration. A minimum of 8 to 10 large-diameter trees per acre would be retained.

- Within units of commercial-thin, sanitation, and individual-tree-selection harvest treatments, overall canopy cover would be reduced by removing shade-tolerant species to encourage ponderosa pine dominance. In the group-selection treatment, ponderosa pine would be regenerated in the openings that are created.

- ***Direct Effects of Action Alternative C to Old Growth***

  The amount, character, and distribution of existing old-growth stands would remain the same within the project area for the short term. Over time, existing covertypes would change with natural plant succession.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A and Action Alternative C to Old Growth***

  Not harvesting in old-growth stands would continue the existing risk of stand-replacement-type fires that would likely consume portions of the old-growth stands in their path.

  Existing open roads would continue to provide access to firewood gatherers, reducing the development of snags and coarse woody debris on those sites.

  Over time and barring large-scale disturbances, FOGI classification levels would increase on most covertypes as climax species mature, decadence increases, and trees die and fall, creating more snags and large woody debris. These same stands would also reach a point where the FOGI classification decreases. As large trees continue to age and eventually die the stand would no longer meet the old-growth definition.

- ***Indirect Effects of Action Alternative B to Old Growth***

  Some mature stands not yet classified as old growth could be considered as old growth in the future. Individual-tree-selection harvesting within these mature stands would increase the diameter growth rates of remaining trees and, in some cases, may hasten the development of old-growth attributes, especially large-diameter trees.

Cumulative Effects

- ***Cumulative Effects Common to All Alternatives***

  Swan River State Forest's salvage permit program did limited harvesting in old growth on the High Blow 02 Salvage Permit. The Big Blow 03 Salvage Permit will propose to do harvesting in old growth. The South Wood Timber Sale has no harvesting within old-growth stands. Following the completion of the permits, updated information will be entered into the SLI database. Cumulative effects for each alternative are the same as shown in *TABLES C-6 - CURRENT AND POST-HARVEST AMOUNTS OF OLD GROWTH BY COVERTYPE IN SWAN RIVER STATE FOREST; TABLE C-7 - FOGI CLASSIFICATIONS BY COVERTYPES FOR SWAN RIVER STATE FOREST;* and *TABLE C-8 - FOGI CLASSIFICATION WITHIN PROPOSED HARVEST AREAS*.

  It may be important to note that timber stands, whether harvesting occurs or not, may be reinventoried or reindexed in regard to adjustments of stand boundaries; a more intensive inventory may change the old-growth status. In addition, implementation of any possible new guidance may change the status and classification of some old-growth stands.

  Past road construction, timber harvests, wildfires, and general site characteristics have led to the current amount of old-growth characteristics in the entire area. The salvage harvesting will not alter old-growth designation, but will reduce some old-growth attribute levels, particularly numbers of large snags and coarse woody debris, as well as potentially decreasing stand decadence. Future sales and thinning projects would likely continue to take place in the analysis area. If additional management projects were proposed, the MEPA process would be implemented.

SENSITIVE PLANTS

ANALYSIS METHODS

The Montana Natural Heritage Program database was searched in March 2001 for plant species and related features of special concern in the vicinity of Swan River State Forest. Two botanists were contracted to perform a site-specific survey for sensitive plants within the project area. Results of this search were then compared to the proposed harvest sites for potential direct and indirect impacts of the proposal. Mitigation measures would be developed, if needed.

The majority of sensitive plants and their related habitat features were found in wet meadows, fens, and riparian areas; these areas are not normally classified as forest stands or considered for timber-harvesting activities. Only 4 plant species and 9 occurrences were found within the Goat Squeezer project area. Of the 4, 2 are associated with moist forest areas, 1 with wet meadows, and the other with freshwater ponds. The moist forested species inhabit open canopy forest with moderate ground vegetation competition from forbs (*Pierce and Barton, 2001*).

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Sensitive Plants***

  Annual seasonal climatic variations and events like drought, flooding, trees blown down across streams, and beaver activity could alter water levels in wet areas, leading to increases or decreases in localized plant populations. Otherwise, there would be no effects to sensitive plants.

- ***Direct Effects of Action Alternatives B and C to Sensitive Plants***

  Sensitive plants associated with wetlands would not be directly affected by any harvesting operations.

Indirect Effects

- ***Indirect Effects of Action Alternatives B and C to Sensitive Plants***

  Given the level of proposed harvesting for this project, no measurable changes in water yield or surface-water levels are anticipated from either proposed action alternative. No change in nutrient levels would occur with the application of mitigation measures to prevent erosion and sediment delivery. Therefore, no indirect effects are expected to the population levels of sensitive plants.

Cumulative Effects

- ***Cumulative Effects of Action Alternatives B and C to Sensitive Plants***

  If water-yield or nutrient-level changes occurred, sensitive plant populations may, in turn, be affected. No measurable changes in water yield or surface-water levels are anticipated from either of the proposed action alternatives, given the level of the proposed and active harvesting on Swan River State Forest and other land in the project area. No change in nutrient levels would occur with the application of mitigation measures to prevent erosion and sediment delivery.

NOXIOUS WEEDS

INTRODUCTION

Spotted knapweed (*Centaurea mauclosa*) and common St. Johns-wort (*Hypercium perforatum*) populations have become established along road edges within the project area. Swan River State Forest has begun a program to reduce the spread and occurrence of noxious weeds.

ALTERNATIVE EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Noxious Weeds***

  Noxious weed populations would continue as they exist. Weed seed would continue to be introduced by recreational use of the forest and log hauling and logging activities on adjacent ownerships. Swan River State Forest may initiate spot spraying to reduce noxious weed spread along roads under the FI program.

- ***Direct and Indirect Effects of Action Alternatives B and C to Noxious Weeds***

  Logging disturbance would provide opportunity for an increased establishment of noxious weeds; log hauling and equipment use would introduce seeds from other sites. Occurrences and the spread of noxious weeds would be reduced by mitigation measures designed to apply integrated weed-management techniques. Grass seeding of new and disturbed roads and landings and spot spraying of new infestations would reduce or prevent the establishment of new weed populations. Requiring machinery to be washed and inspected prior to entering the project area would reduce the introduction of noxious weed seeds into the forest. Roadside herbicide spraying would reduce existing noxious weed populations. All herbicide spraying would be strictly controlled to follow label directions, prevent introduction of chemicals into riparian systems, and target only the intended noxious weed species.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Noxious Weeds***

  Salvage logging on State land and logging activities on adjacent lands will continue to provide an opportunity for noxious weeds to

become established. Current population levels would continue and may increase over time.

- ***Cumulative Effects of Action Alternatives B and C to Noxious Weeds***

These proposed action alternatives, together with other management and recreational activities on Swan River State Forest, would provide an opportunity for the transfer of weed seed from various sites and an increased establishment of noxious weeds. Both prevention actions through the County Weed Board and active weed-management activities would be used to reduce the spread and establishment of noxious weeds and the resulting replacement of natural vegetation. Swan River State Forest would continue to provide some level of weed management through this action and with other management programs.

APPENDIX D

HYDROLOGY

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX D
HYDROLOGY ANALYSIS

INTRODUCTION

This analysis is designed to disclose the existing condition of the hydrologic resources and display the anticipated effects that may result from each alternative of this proposal. During the initial scoping and subsequent newsletter comments, the following issues were expressed regarding the effects of the proposed timber harvesting:

- Minimum buffer zones, as required by the SMZ law, may be inadequate to protect streams from increased sediment introduction.
- Timber removal activities within the SMZ may alter fisheries habitat by reducing pool formation. Generally, this refers to large woody debris removal, which is a catalyst for pool formation.

  No harvesting is proposed in the SMZs under any of the alternatives. Due to the lack of harvesting in SMZs and DNRC-extended SMZs, large woody-debris recruitment will not be affected and, therefore, no further analysis is deemed appropriate. The *Fisheries Analysis* provides more information on this issue.

- Timber-harvesting activities may increase sediment introduction to streams from in-channel and out of channel sources.

These issues can best be evaluated by analyzing the anticipated effects of sediment delivery and water yield on the water quality of the streams located within the project area.

SEDIMENT DELIVERY

Timber harvesting and related activities, such as road construction or reconstruction, can lead to impacts to water quality by increasing the production and delivery of fine sediment to streams. Constructing, maintaining, and using roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material.

WATER YIELD

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase as the percentage of canopy removal increases because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which may lead to additional increases in water yield. The additional water

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yield increases may result in increased magnitude and duration of peak flows, which can result in accelerated streambank erosion and sediment deposition.

ANALYSIS METHODS

SEDIMENT DELIVERY

The methodology for analyzing sediment delivery was completed using a detailed sediment-source inventory that include quantitative and/or qualitative information. Roads and stream crossings were evaluated to determine existing sources of introduced sediment. Sediment source surveys were conducted using methods commonly used by DNRC when conducting watershed inventories and the *Washington Forest Practices: Watershed Analysis Methodology*. In addition, in-channel sources of sediment were identified during stream inventories. These inventories were conducted in 2000 through 2002 by DNRC hydrologists. Plum Creek Timber Company and Land and Water Consulting, Inc., completed other sediment-source assessment work. The data from Plum Creek can be found in a report titled, *Goat Creek and Piper Creek Watershed Analysis (Plum Creek Timber Company 1996)*. Data from Land and Water Consulting, Inc., is considered preliminary data, but was used to help validate data from other sources.

In addition to looking at potential sources of sediment introduction from roads, potential sediment introduction to streams from harvest units will be addressed by discussing the effectiveness of buffer zones along streams.

WATER YIELD

Annual water-yield increases will be used as an indicator of potential increases to in-channel erosion.

Potential increases in annual water yield for the watersheds in the project area were estimated using the ECA method, as outlined in *Forest Hydrology, Part II (1976)*.

ECA is a function of total area roaded, harvested, or burned, percent of crown removed during harvesting or wildfires, and amount of vegetative recovery that has occurred in the harvested or burned areas. This method equates the area harvested and percent of crown removed with an equivalent amount of clearcut area. For example, if 100 acres had 60 percent of its crown removed, the ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent of ECA is not always the same as the percent of crown removal. As live trees are removed, the water that would have evaporated and transpired either saturates the soil or is translated to runoff. This method also calculates the recovery of these increases as new trees vegetate the site and move toward the preharvest or prefire water use.

In order to evaluate the watershed risk of increases in water yield effectively, a threshold of concern for each watershed was established. Thresholds were established based on evaluating the acceptable risk level, resource value, and watershed sensitivity. Watershed sensitivity was evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II (USFS 1976)*. The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy reduction, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks erode at an accelerated rate. The more stable streams are better able to handle larger increases in water yield before they begin to erode, while less stable streams will have a greater potential to experience erosion at more moderate water-yield increases.

Water yield will be disclosed as a cumulative effect in the *EXISTING CONDITIONS* portion of this report because the existing condition is a result of all past harvesting and associated activities. In the *ENVIRONMENTAL EFFECTS* portion of this report, increases in water yield as a result of this project will be disclosed as a direct effect. The cumulative water-yield increase, as predicted to include each alternative, will be disclosed as a cumulative effect.

ANALYSIS AREA

The *WATERSHEDS IN PROJECT AREA* map can be found at the end of this report. This map has been added to exhibit the general watershed sizes.

SEDIMENT DELIVERY

The analysis area for sediment delivery are the watersheds for Goat, Squeezer, Napa, and Squaw/ Perry creeks. The analysis will cover all stream segments within the watershed and all roads and upland sites that may contribute sediment to each stream.

WATER YIELD

The analysis areas for water yield are the Goat Creek watershed above the confluence with Squeezer Creek, and the Squeezer Creek, Napa Creek, and Van Lake watersheds.

CUMULATIVE EFFECTS

The analysis areas for cumulative effects will be the entire Goat Creek watershed, which includes the Squeezer Creek, Napa Creek; and Van Lake watersheds.

REGULATORY FRAMEWORK

MONTANA SURFACE WATER-QUALITY STANDARDS

According to Administrative Rules of Montana (*ARM) 17.30.608 (2)(a)*, the Swan River drainage, including all streams in the project area, is classified as B-1. Among other criteria for B-1 waters, no increases are allowed above naturally occurring levels of sediment and a minimal increase over natural turbidity is allowed. Naturally occurring, as defined by ARM 17.30.602 (17), includes conditions of materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and the operations and maintenance procedures. Appropriate practices may be applied before, during, or after impactive activities.

BENEFICIAL USES AND WATER RIGHTS

Designated beneficial water uses within the project area include the domestic water supply, coldwater fisheries, and recreational use.

WATER-QUALITY-LIMITED WATERBODIES

Within the project area there are 2 streams, Goat and Squeezer creeks named in the 1996 303(d) list (*Waterbodies in Need of Total Maximum Daily Load [TMDL] Development*) publications produced by DEQ (DEQ 1996). The 2000 and 2002 303(d) lists do not list Squeezer Creek as a water body in need of a TMDL, as it fully meets all beneficial uses. The one exception is drinking water, which has insufficient credible data for assessment. The listed probable causes of impairment are flow alteration, organic enrichment/ dissolved oxygen, other habitat alterations, and siltation. The probable sources of impairment listed are agriculture, natural sources, pastureland, and silviculture. Waterbodies listed as water-quality limited are prioritized by DEQ for development of a TMDL. Goat and Squeezer creeks are listed as a low priority for TMDL development (DEQ 1996). A TMDL is currently being

developed for Swan Lake and its tributaries, including Goat Creek.

Until a TMDL is developed under Montana Law (*MCA 75-5-703*), new or expanded activities that may further the listed impairment may commence and continue, provided they are conducted using all reasonable land, soil, and water conservation practices (BMPs).

SMZ LAW

All rules and regulations pertaining to the SMZ Law would be followed. By the definition in *ARM 36.11.301*, the major streams in the project area are considered to be Class I due to the perennial flow and presence of fish. First- and second-order tributaries to the major streams may be classified as Class I or II streams, depending on the length of time each stream flows.

An SMZ width of 100 feet is required on Class I and II streams when the slope is greater than 35 percent. An SMZ width of 50 feet is required when the slope is equal to or less than 35 percent.

EXISTING CONDITIONS

➢ Goat And Squeezer Creeks

The basin of Goat and Squeezer creeks is a 22,275-acre watershed on the eastern side of Swan Valley. Squeezer Creek comprises approximately 8,995 acres of the basin area and is the major tributary to Goat Creek, although 2 other named streams, Scout and Bethel creeks, contribute flow. Scout and Bethel creeks are located above the project area and, therefore, will not be analyzed in the effects portion of this report, except during the cumulative effects.

The headwaters of the Goat-Squeezer watershed originate in the Swan Range, and the basin drains west to Swan River, south of Swan Lake. Elevation ranges from 9,154 feet at Swan Peak to 3,219 feet at the outlet (*Plum Creek, 1996*). Ownership within the basin of Goat and Squeezer creeks is divided between 3 landowners. USFS manages approximately 59 percent (13,115 acres) of the drainage; Plum Creek Timber Company owns about 26 percent (5,790 acres); and, DNRC manages the remaining 15 percent (3,370 acres).

Sediment Delivery

As described under the *ANALYSIS METHODS* portion of this report, potential sediment delivery was identified from in-channel, road, and upland sources. DNRC hydrologists gathered in-channel information on sediment sources. Other information regarding in-stream sedimentation was completed by Plum Creek Timber Company. Existing and potential upland sources of sediment delivery to streams were supplied by DNRC hydrologists and foresters, Plum Creek Timber Company, and Land and Water Consulting in conjunction with the Swan Lake TMDL. It must be noted that the data from Land and Water Consulting is considered to be preliminary data by that company. This data has been used because it closely mimics the results of other sediment-source inventories.

In-Channel Sediment

During August of 2000, portions of Goat and Squeezer creeks were inventoried for in-stream sediment sources, as well as for general channel stability. Goat Creek was inventoried from the middle of Section 11, T23N, R17W, downstream to the confluence with Swan River. Squeezer Creek was inventoried from Section 26, T23N, R17W, downstream to the confluence with Goat Creek. In addition to the main stem, several tributaries were inventoried for channel instability that may contribute

sediment to the main stem.

The main stem of Goat Creek is, generally, a stable stream with limited in-stream sediment sources. Substantial sediment sources were found in only 2 locations along the stream. Each of these locations resulted from a large tree falling across the stream. In these instances, the newly created slope will commonly ravel and adjust to a more stable angle.

A greater quantity of sediment is produced from the persistent bank erosion of alluvial terraces, augmented by the larger-scale erosion of terraces when debris jams form and force the channel to cut a new path. This process is referred to as channel migration (*Plum Creek Timber Company, 1996*). Debris jams are common in most reaches of Goat Creek. These debris jams store sediment until the debris jam fails and the sediment is released.

The unnamed tributaries to Goat Creek that were inventoried exhibited no signs of instability, except for a stream in Section 6, T23N, R16W. This stream was recently heavily scoured. Speculation points toward a debris flow during the spring of 1997 that severely scoured this channel and presented a sediment source to Goat Creek. This stream is on USFS-managed land and is upstream from all DNRC-managed land; therefore, this stream will not be analyzed further.

The main stem of Squeezer Creek varies by reach in regards to in-stream sediment sources. The inventoried upper reaches (Section 26) are characterized as stable with little or no channel cutting or bank erosion due to the amount of rock found in the banks. The uppermost reach is a boulder-type channel with step-pool sequences. Below the bridge in Section 27, the gradient of the channel decreases and locations of past debris jams become evident. Banks in this reach are armored by large rock, resulting in very little bank erosion.

As Squeezer Creek flows downstream from the western half of Section 27 through Section 21, side channels become more frequent. Banks are generally stable through this area, but, due to the amount of woody debris present, channel migration has a higher potential. As the stream winds into Section 20, past mass failures show up periodically. Some of the mass-wasting sites have revegetated and healed while others still look fresh. Debris jams are less frequent in this area, although large woody debris is common to abundant.

Tributaries to Squeezer Creek throughout the inventoried section are generally intermittent. Some of the tributaries show intermittent signs of scour, while others are considered to be ephemeral draws. Although intermittent streams can contribute sediment to downstream waterbodies, no in-stream sediment sources were found.

Upland Sources of Sediment

Upland sources of sediment are most often associated with roads and stream crossings, which may be long-term sources, or catastrophic events such as wildfires and landslides, which are generally short-term sources of sediment. Smaller amounts of sediment can be delivered from upland management activities if proper planning and mitigation is applied.

The Plum Creek Timber Company watershed analysis (*Plum Creek Timber Company, 1996*) and the

Land and Water Consulting Reports (Land and Water 2002) identified 18 locations of sediment delivery in the Goat and Squeezer watersheds. Although a majority of the sites identified as sediment sources were identical, there were locations that differed by report.

It is estimated that these upland sources contribute approximately 25 tons of sediment to Goat Creek on an annual basis and an additional 5.5 tons of sediment to Squeezer Creek (*Land and Water Preliminary Report, 2002*). Of these preliminary estimates, 0.2 tons of sediment in the Goat Creek watershed and 4.9 tons of sediment in the Squeezer Creek watershed are attributed to roads on State land.

➢ Squaw/Perry Creeks

The watershed of Squaw and Perry creeks consists of 5,630 acres located east of Highway 83 on the floor of Swan Valley. Both streams are low-gradient Class I channels that flow west and north into Swan River. Elevations range from 6,440 feet at Napa Point to 3,150 feet at the confluence with Swan River. Ownership within the Squaw/Perry watershed is divided between 3 landowners. DNRC manages approximately 50 percent (2,825 acres) of the drainage, Plum Creek Timber Company owns about 45 percent (2,540 acres), and USFS manages the remaining 5 percent (265 acres).

Sediment Delivery

In-channel Sediment Sources

During the spring of 2002, DNRC hydrologists inventoried Squaw and Perry creeks to identify in-stream sediment sources. Most of the stream lengths in this watershed are low gradient, intermittent, and intermingled with swamps and wetlands. These low-gradient streams showed little to no bank cutting other than at outcurves and constrictions.

Upland Sediment Sources

Gates and earth berms generally restrict the roads within this watershed, which results in very little traffic. Roads are grassed over and have gentle slopes, which reduces the sediment transport potential. No quantitative sediment inventory was completed for this watershed.

➢ Napa Creek

Napa Creek is a 1,520-acre, Class I tributary to Soup Creek that flows east to west on the eastern flank of Swan Valley. The majority of Napa Creek is managed by DNRC (1,475 acres), with the remaining 45 acres of the watershed being managed or owned by USFS or Plum Creek Timber Company. Elevations of this watershed range from 7,000 feet on Napa Ridge to 3,450 feet at the confluence with Soup Creek.

Sediment Delivery

In-Channel Sediment Sources

Wetlands located just above the confluence of Napa Creek with Soup Creek serve to filter any sediment transported in Napa Creek. This stream has 2 distinct reaches defined by the gradient. The upper reach is characteristic of a headwater stream with a rocky channel bottom and rock-filled banks that are moderately resistant to bank cutting. The width of the stream as the "Goat-Soup cutacross" road crosses it in Section 34 is approximately 6 feet. Less than half-mile downstream, the stream is subsurface and no signs of surface flow are present. This continues until the wetlands in the lower portion of Section 33 collect water from the water table and the lower reach of the

stream forms. The lower reach is a somewhat lower-gradient channel with less rock in the streambank. However, with lower gradients there is less velocity and, thus, less erosiveness. The lower channel shows little sign of bank cutting, except around debris jams and woody debris.

Upland Sediment Sources

Napa Creek has only 1 stream crossing, which is located in the lower reach described above. The existing stream crossing does not currently meet BMP standards. The creek is relatively flat in the area of the road crossing, which limits the risk of sediment being transported on the road prism, but the crossing needs a roll over the culvert to route road-surface drainage away from the crossing. The culvert also needs to be extended to eliminate the potential for direct sediment delivery.

- ### Van Lake Watershed

The Van Lake watershed is a 5,525-acre intermittent watershed that flows from 2 sources: Van Lake and the headwater streams in the Swan Range on the eastern flank of Swan Valley. Elevations range from 7,650 feet in the headwaters to approximately 3,350 feet at the mapped confluence with Swan River.

Sediment Delivery

In-stream Sediment Sources

As described in the Environmental Assessments for the Small Squeezer and Small Squeezer II timber sale projects, the Van Lake watershed is drained by a series of intermittent creeks and ephemeral draws, with the most pronounced hydrologic features being a series of wetlands and Van Lake. Some of the intermittent scoured channels within the watershed actually contribute flow to "sink" watersheds, which are natural low spots with no surface water outlets. Stream channels in the Van Lake watershed are stable with no active erosion or deposit features.

Upland Sediment Sources

No identified upland sources of sediment in this watershed exist due to recent improvements made in association with the Small Squeezer and Small Squeezer II timber sales during 1999 and 2000. Recent BMP audits completed by DNRC hydrologists note that adequate protection for soil and water resources was accomplished and BMPs were met on the transportation system for the Small Squeezer and Small Squeezer II timber sales.

WATER YIELD

Thresholds were set for each watershed, as deemed appropriate, using the methodology described earlier in this report. Swan River State Forest is managed with a low degree of risk. This low level of risk reduces the allowable cumulative annual water-yield increase.

By looking at the channel conditions and hydrologic nature of each watershed and the resources present, a cumulative annual water-yield threshold is set. *TABLE D-1 - ANNUAL WATER YIELD THRESHOLDS FOR WATERSHEDS IN THE PROJECT AREA* displays the annual water-yield thresholds for each watershed in the project area, with the exception of Napa Creek. Due to the limited amount of harvesting proposed in the Napa Creek watershed, the current condition of the channel, and the low potential for adverse impacts to the stream channel, a detailed water-yield analysis was not warranted.

TABLE D-1 - ANNUAL WATER YIELD THRESHOLDS FOR WATERSHEDS IN THE PROJECT AREA

WATERSHED	THRESHOLD (PERCENT)	CURRENT ANNUAL WATER-YIELD INCREASE (PERCENT)
Goat Creek, which includes Squeezer Creek	10	7.1
Squeezer Creek	10	5.5
Goat Creek *only*	10	5.0
Squaw/Perry Creeks	11	8.0
Van Lake	12	4.5

ENVIRONMENTAL EFFECTS

DESCRIPTION OF ALTERNATIVES

- ***No-Action Alternative A Description***

  No-Action Alternative A involves no timber harvesting, road construction, or related activities.

- ***Action Alternative B Description***

  Approximately 2,444 acres of harvest units would be harvested with varying prescriptions, ranging from commercial thinning to seedtree. Of the 2,444 acres, 426 acres would be harvested using cable-yarding methods, and the remaining 2,018 acres would use ground-based methods.

  Roadwork associated with this alternative includes constructing 2.9 miles of permanent road and 1.1 miles of temporary road, reconstructing 3.3 miles, decommissioning approximately 0.5 miles of road, and improving 47.7 miles to a standard that meets BMPs. The total miles of road proposed for use under this alternative would be 5.5 miles.

- ***Action Alternative C Description***

  Approximately 1,866 acres of harvest units would be harvested with varying prescriptions, ranging from commercial thinning to seedtree. Of the 1,866 acres, 328 acres would be harvested using cable yarding methods and the remaining 1,537 acres would employ ground-based yarding methods.

  Roadwork associated with this alternative includes constructing 1.0 miles of permanent road and 0.8 miles of temporary road, decommissioning approximately 0.5 miles of road, constructing 3.3 miles of road, and improving 33.6 miles. The total miles of road proposed for use under this alternative would be 35.4 miles.

ALTERNATIVE EFFECTS

Sediment Delivery

Direct Effects

- ***Direct Effects of No-Action Alternative A to Sediment Delivery***

  No-Action Alternative A would have no direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in-stream and upland, would continue to recover or degrade, based on natural or preexisting conditions. Upgrading BMPs on roads located within in the project area would occur as funding allows.

- ***Direct Effects of Action Alternative B to Sediment Delivery***

  Direct effects under Action Alternative B include a reduced sediment-delivery potential from existing roads used in conjunction with the proposed timber harvest. The proposed road improvements would eliminate or substantially reduce existing and potential sediment sources identified on area roads, especially on stream crossings. Under implementation of Action Alternative B, the total amount of sediment delivery to streams in the project area would be reduced.

  In addition to replacing 3 stream crossings in Section 26 during construction activities,

approximately 48 miles of road within the project area would be improved to fully meet BMPs. Upgrading existing roads to current BMP standards and maintaining roads that presently meet BMP standards would further reduce the risk of sediment delivery.

In the process of improving BMPs on existing roads for a long-term reduction in sediment delivery, a short-term increase in sediment delivery potential would occur while replacing 3 stream crossings in Section 26, T23N, R17W. Site-specific erosion-control and mitigation measures would be designed and implemented to reduce the risk of sediment introduction during and immediately after culvert replacement. Due to the implementation of mitigation measures to reduce the risk of long-term sediment delivery during the culvert installation, adverse impacts to beneficial uses would not likely occur.

Approximately 4.0 miles of road construction would be completed under this alternative. In general, the road construction would be done to extend existing roads. Proposed road construction would take place at least 165 feet away from streams, except to cross 2 tributaries to Goat Creek. One of the tributaries is an ephemeral draw and the other tributary is a stable, low-gradient, first-order stream. The low-gradient stream is buffered from Goat Creek with a series of beaver dams that would serve to filter sediment. Roads constructed in conjunction with this alternative would be obliterated or restricted at the close of the contract period.

Site-specific erosion-control and mitigation measures would be designed and implemented to reduce the risk of sediment introduction during and immediately after culvert installation. Due to the implementation of mitigation measures to reduce the risk of long-term sediment delivery during culvert installation, adverse impacts to beneficial uses would not likely occur.

In-stream sediment sources are most affected by water-yield increases. Therefore, the potential adverse in-stream erosion will be disclosed in the portion of this report regarding cumulative effects to water yield.

- ***Direct Effects of Action Alternative C to Sediment Delivery***

Direct effects under Action Alternative C include a reduced sediment-delivery potential from existing roads used in conjunction with the proposed timber harvest. The proposed road improvements would eliminate or reduce existing and potential sediment sources identified on area roads, especially on stream crossings. Eliminating or reducing the sediment sources identified on area roads, especially on the inadequate stream crossings, would reduce the amount of sediment delivery to streams in the project area.

In addition to replacing 3 stream crossings in Section 26, approximately 35.4 miles of road within the project area would be improved to fully meet BMPs. Upgrading existing roads that do not meet current BMP standards and maintaining roads that presently meet BMP standards would further reduce the risk of sediment delivery.

Approximately 1.7 miles of road construction would be completed under this alternative. In general, road construction would be done to extend existing roads. Two crossings would be installed on tributaries to Goat Creek. These crossings were described in the previous section and will not be described again. Roads

constructed in conjunction with this alternative would be either obliterated or restricted at the close of the contract period.

Because road construction is located away from streams and stream crossings would be designed to minimize sediment introduction, sediment generated from road construction would not likely be transported to waterbodies and, therefore, would not adversely affect beneficial uses.

In-stream sediment sources are most affected by water-yield increases. Therefore, the potential adverse in-stream erosion will be disclosed in the water-yield portion of this report.

Indirect Effects

- ***Indirect Effects of No Action Alternative A to Sediment Delivery***

  No timber harvesting or associated activities would occur; therefore, no indirect effects would be expected beyond those occurring under existing conditions to sediment delivery if this alternative were implemented.

- ***Indirect Effects of Action Alternative B to Sediment Delivery***

  Due to the type of soils in the project area and stream buffers, the proposed harvest units in this alternative present a low potential of sediment delivery to streams. A description of the soils in the area can be found in *APPENDIX G – SOILS ANALYSIS* of this EIS. For wildlife mitigation, all perennial streams in the project area would have a 165-foot, no-harvest buffer, and intermittent streams would have an 83-foot, no-harvest buffer. This buffer would be more than is legally required under the SMZ law and would serve to protect area streams from sediment introduction by filtering out sediment disturbed during timber-harvesting operations. General information on soils in the project area shows that soils present readily accept infiltration of runoff. Due to the moderate infiltration capacity of the soils in the area and the vegetation present, soil disturbed during the timber-harvesting operation would not likely travel to waterbodies in the project area.

  The seasons of operation and methods of harvesting would also affect the risk of sediment delivery to streams. Under this alternative, 2,018 acres would be harvested using ground-based yarding methods. Of these 2,018 acres of proposed harvesting, 714 acres would be completed during winter. Timber harvesting under winter conditions results in less potential soil disturbance than summer operations because equipment is operated on snow.

  Summer tractor yarding on the remaining 1,301 acres would be completed using forestry BMPs. By implementing BMPs, the risk of disturbance (displacement and/or compaction) is reduced and, thus, the erosion potential is lessened. By reducing the risk of erosion, the potential for sediment delivery is lowered.

  Taking all of the BMPs and mitigation measures into account, the risk of sediment delivery from harvest units to streams is low. Therefore, beneficial uses and water quality would not likely be adversely affected if this alternative were selected.

- ***Indirect Effects of Action Alternative C to Sediment Delivery***

  Due to the type of soil in the project area and stream buffers, the proposed harvest units in this alternative would present a low potential of sediment delivery to streams. A description of the soils in the area can be found in *APPENDIX G – SOILS ANALYSIS* of

this EIS. All perennial streams in the project area would have a 165-foot, no-harvest buffer, and intermittent streams would have an 83-foot, no-harvest buffer as wildlife mitigation. This buffer would be more than is legally required under the SMZ law and would serve to protect area streams from sediment introduction by filtering out sediment disturbed during timber-harvesting operations. General information on soils in the project area show that the soils present readily accept infiltration of runoff. Due to the infiltration capacity of the soils in the area and the vegetation present, soil disturbed during the timber-harvesting operation would not likely travel to waterbodies in the project area.

The seasons of operation and methods of harvesting would also affect the risk of sediment delivery to streams. Under this alternative, 1,538 acres would be harvested using ground-based yarding methods. Of these 1,538 acres of proposed harvesting, 368 would be completed during the winter. Timber harvesting under winter conditions results in less potential soil disturbance than summer operations because equipment is operating on snow.

Summer tractor yarding on the remaining 1,170 acres would be completed using forestry BMPs. By implementing BMPs, the risk of disturbance (displacement and/or compaction) is reduced and, thus, the erosion potential is lessened. By reducing the risk of erosion, the potential for sediment delivery is lowered.

Taking all BMPs and mitigation measures into account, the risk of sediment delivery to streams from harvest units is low. Therefore, it is unlikely that beneficial uses and water quality would be adversely affected if this alternative were selected.

Cumulative Effects

Sediment Delivery

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

  No timber harvesting or associated activities would occur; therefore, no additional cumulative effects to sediment delivery would be expected beyond those occurring under existing conditions as a result of implementing No-Action Alternative A.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

  Cumulative effects to potential sediment-delivery would occur as a result of fixing existing sediment sources on roads within the project area. Upgrading or maintaining the BMP structures on area roads would reduce the overall risk of sediment delivery to streams.

  The new road construction proposed under this alternative would increase the miles of road within the project area. However, due to the location of the proposed road construction and the prescription to obliterate or restrict road use on the new construction, it is unlikely that adverse cumulative effects to sediment delivery would result.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

  Cumulative effects to sediment delivery potential would occur as a result of fixing existing sediment sources on roads within the project area. Upgrading or maintaining the BMP structures on area roads would reduce the overall risk of sediment delivery to streams.

  The new road construction proposed under this alternative would increase the miles of road within the project area. However, due to

the location of the proposed road construction and the prescription to obliterate or restrict road use on the new construction, it is unlikely that adverse cumulative effects to sediment delivery would result.

Water Yield

- ***Direct Effects of No-Action Alternative A to Water Yield***

  No timber harvesting or associated activities would occur; therefore, no direct effect to water yield would occur.

- ***Direct Effects of Action Alternative B to Water Yield***

  Action Alternative B, as described earlier, would increase the annual water yield in most of the watersheds within the project area. The direct effects to annual water yield by watershed are shown in *TABLE D-2 - DIRECT EFFECTS TO WATER YIELD UNDER ACTION ALTERNATIVE B*.

TABLE D-2 - DIRECT EFFECTS TO WATER YIELD UNDER ACTION ALTERNATIVE B

WATERSHED	ACRES OF HARVEST	EQUIVALENT CLEARCUT ACRES (ECA)	PERCENT ANNUAL WATER YIELD INCREASE
Goat Creek	465	282	0.3
Squeezer Creek	655	467	0.9
Napa Creek	55	10	<0.1
Squaw/Perry Creeks	607	456	2.7
Van Lake	571	226	1.1
Swan River	85	49	<0.1

Due to the channel characteristics and existing sediment-delivery attributes described in *EXISTING CONDITIONS*, it is unlikely that the water-yield increase, shown above, would result in substantial channel adjustments and increased in-stream erosion potential.

- ***Direct Effects of Action Alternative C to Water Yield***

  Action Alternative C, as described earlier, would increase the annual water yield in most of the watersheds within the project area. The direct effect to the annual water yield by watershed is shown below in *TABLE D-3 - DIRECT EFFECT TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE C*.

TABLE D-3 - DIRECT EFFECT TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE C

WATERSHED	ACRES OF HARVEST	EQUIVALENT CLEARCUT ACRES (ECA)	PERCENT ANNUAL WATER YIELD INCREASE
Goat Creek	418	274	0.3
Squeezer Creek	550	381	0.4
Napa Creek	55	10	<0.1
Squaw/Perry Creeks	530	402	2.4
Van Lake	228	136	0.7
Swan River	85	49	<0.1

Due to the channel characteristics and existing sediment-delivery attributes described in *EXISTING CONDITIONS*, it is unlikely that the water-yield increase shown above would result in substantial channel adjustments and increased in-stream erosion potential.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Water Yield***

  No timber harvesting or associated activities would occur; therefore, no indirect effects to water yield were identified.

- ***Indirect Effects of Action Alternative B to Water Yield***

  No indirect effects to the annual water yield would occur. Since water yield is a direct result of removing canopy cover, all effects associated with annual water yield are considered in the sections addressing direct and cumulative effects.

- ***Indirect Effects of Action Alternative C to Water Yield***

  No indirect effects to the annual water yield were identified. Since water yield is a direct result of removing canopy cover, all effects associated with annual water yield are considered in the sections addressing direct and cumulative effects.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Water Yield***

  No timber harvesting or associated activities would occur; therefore, no additional cumulative effects to water yield would occur.

- ***Cumulative Effects of Action Alternative B to Water Yield***

  Action Alternative B, as described earlier, would increase the annual water yield in most of the watersheds within the project area. The cumulative effect to the annual water yield by watershed is displayed in *TABLE D-4 - CUMULATIVE EFFECTS TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE B.*

TABLE D-4 - CUMULATIVE EFFECTS TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE B

WATERSHED	THRESHOLD (PERCENT)	CUMULATIVE PERCENT ANNUAL WATER-YIELD INCREASE
Goat Creek, including Squeezer Creek	10	5.3
Squeezer Creek	10	6.4
Goat Creek *only*	10	7.6
Squaw/Perry Creeks	11	10.7
Van Lake	12	5.6

With all of the watersheds staying well below the threshold of concern, it is unlikely that the cumulative annual water-yield increase would result in substantial channel adjustments. Therefore, no increased in-stream erosion would be expected.

- ***Cumulative Effects of Action Alternative C to Water Yield***

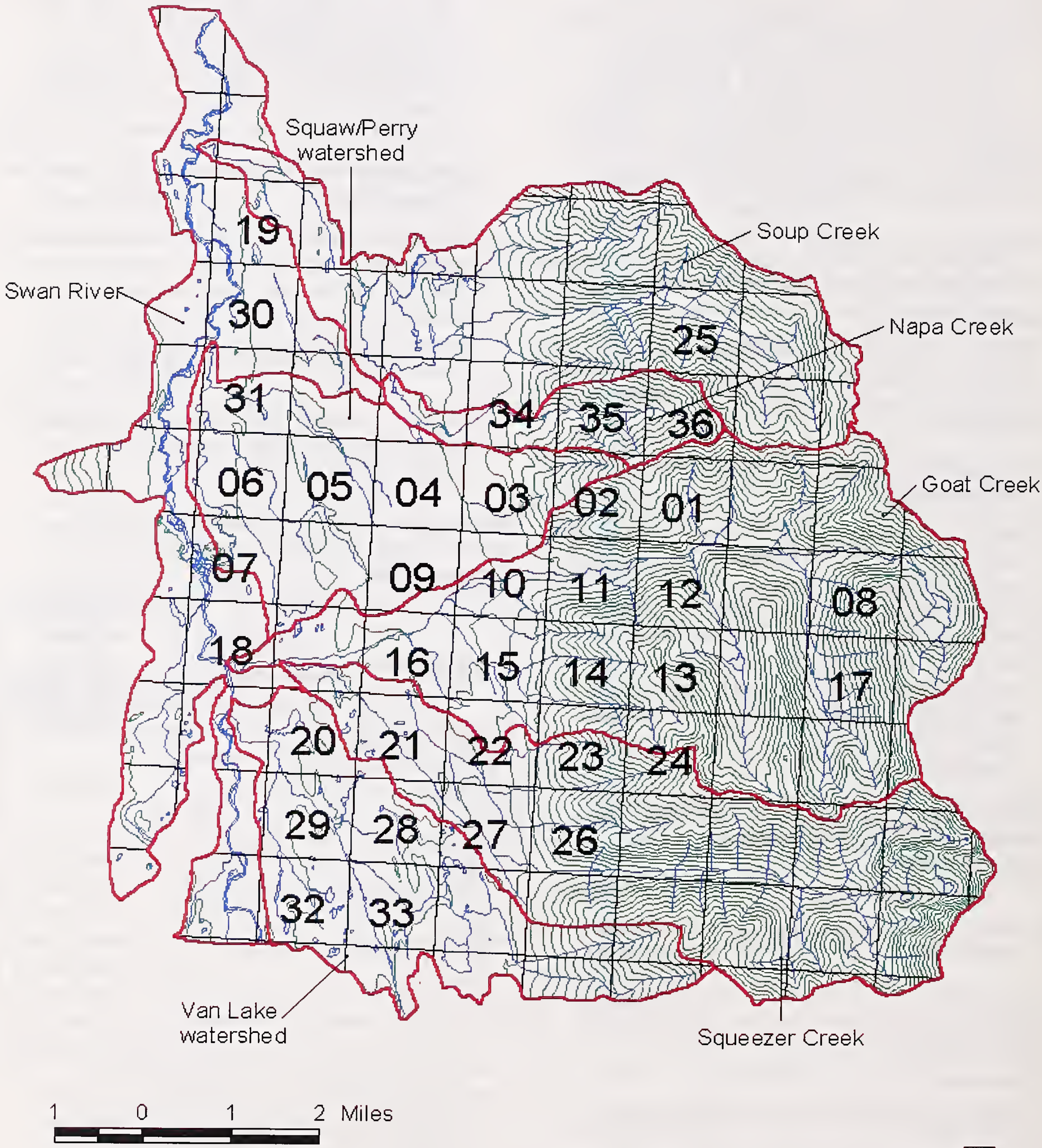
  Action Alternative C, as described earlier, would increase the annual water yield in most of the watersheds within the project area. The cumulative effect to the annual water yield by watershed is shown below in *TABLE D-5 - CUMULATIVE EFFECT TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE C.*

TABLE D-5 - CUMULATIVE EFFECT TO ANNUAL WATER YIELD UNDER ACTION ALTERNATIVE C

WATERSHED	THRESHOLD (PERCENT)	CUMULATIVE PERCENT ANNUAL WATER-YIELD INCREASE
Goat Creek, including Squeezer Creek	10	5.2
Squeezer Creek	10	5.9
Goat Creek *only*	10	5.3
Squaw/Perry Creeks	11	10.4
Van Lake	12	5.2

With all of the watersheds staying well below the threshold of concern, it is unlikely that the cumulative annual water-yield increase would result in substantial channel adjustments. Therefore, no increased in-stream erosion would be expected.

GOAT SQUEEZER TIMBER SALE PROJECT PROPOSAL WATERSHEDS IN THE PROJECT AREA



Fisheries

APPENDIX E

FISHERIES

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX E

FISHERIES ANALYSIS

INTRODUCTION

During the initial scoping and subsequent newsletter comments, the following issues were expressed regarding the effects of the proposed timber harvesting:

- Land management activities may degrade physical habitat in area streams.
- Fish populations could be affected if fish habitat is degraded.

The analysis area considered under the proposed Goat-Squeezer Timber Sale Project include potential harvest units within the following drainages:

- Goat Creek,
- Squeezer Creek,
- Napa Creek,
- Squaw Creek,
- Perry Creek,
- Swan River, and
- the Van Lake watershed.

The analysis area supports native salmonid species, including bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). *TABLE E-1 - SALMONID* PRESENCE (DESIGNATED X) AND ABSENCE IN WATERBODIES OF ANALYSIS AREA* and *FIGURE E-1 - SALMONID SPECIES COMPOSITION, DISTRIBUTION, AND PASSAGE BARRIERS OF THE ANALYSIS AREA* displays species distribution. Bull trout are Federally listed as "threatened" under the Endangered Species Act and westslope cutthroat trout are considered a "Class A species of special concern"

TABLE E-1 - SALMONID* PRESENCE (DESIGNATED X) AND ABSENCE IN WATERBODIES OF ANALYSIS AREA

WATERBODY	***BULL TROUT***	***WESTSLOPE CUTTHROAT TROUT***	***BROOK TROUT***	***RAINBOW TROUT***
Goat Creek	X	X	X	X
Squeezer Creek	X	X	X	
Unnamed Tributary (Section 15)		X		
Scout Creek	X			
Bethal Creek	X			
Squaw Creek			X	
Napa Creek		X	X	
Perry Creek			X	
Van Lake				X
Swan River (upstream of Swan LAKE)	X	X	X	X

**Excluding mountain whitefish. Sources- Leathe et. al (1985), Plum Creek (1996), Rumsey (2001).*

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through a joint listing developed by DFWP and the Montana Chapter of the American Fisheries Society. Class A species are those that are limited in numbers and/or habitat both in Montana and elsewhere in North America; elimination from Montana would be a significant loss to the gene pool of the species.

The State of Montana has developed a Restoration Plan for Bull Trout in the Clark Fork and Kootenai Basins (*Montana Bull Trout Restoration Team, 2000*). The entire Goat and Squeezer drainages were closed to angling year-round by DFWP in 1985. In 1993, harvesting of bull trout was eliminated in Montana, including the Swan River and its tributaries. The only exception to the Statewide closure is Swan Lake, which remains open with a daily creel limit of 1 bull trout.

Other native species in the analysis area include another salmonid, mountain whitefish (*Prosopium williamsoni*) and sculpin (*Cottus spp.*). Nonnative salmonid species found in the analysis area include rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*). According to DFWP information cited in *Plum Creek (1996)*, the stocking of brook trout into Swan River tributaries began in 1926 and continued routinely throughout the 1950s. Rainbow trout were first introduced into the Swan River basin in 1932. As with brook trout, intensive stocking efforts for rainbow trout were continued until around 1950 (see *FIGURE E-1 - SALMONID SPECIES COMPOSITION, DISTRIBUTION, AND PASSAGE BARRIERS OF THE ANALYSIS AREA)*.

The bull trout and westslope cutthroat trout population in the analysis area support 3 possible life history patterns that can occupy vast geographic areas (see *TABLE E-2 - GENERAL TIME FRAME OF LIFE HISTORY CHARACTERISTICS OF BULL TROUT AND WESTSLOPE CUTTHROAT OF THE ANALYSIS AREA)*:

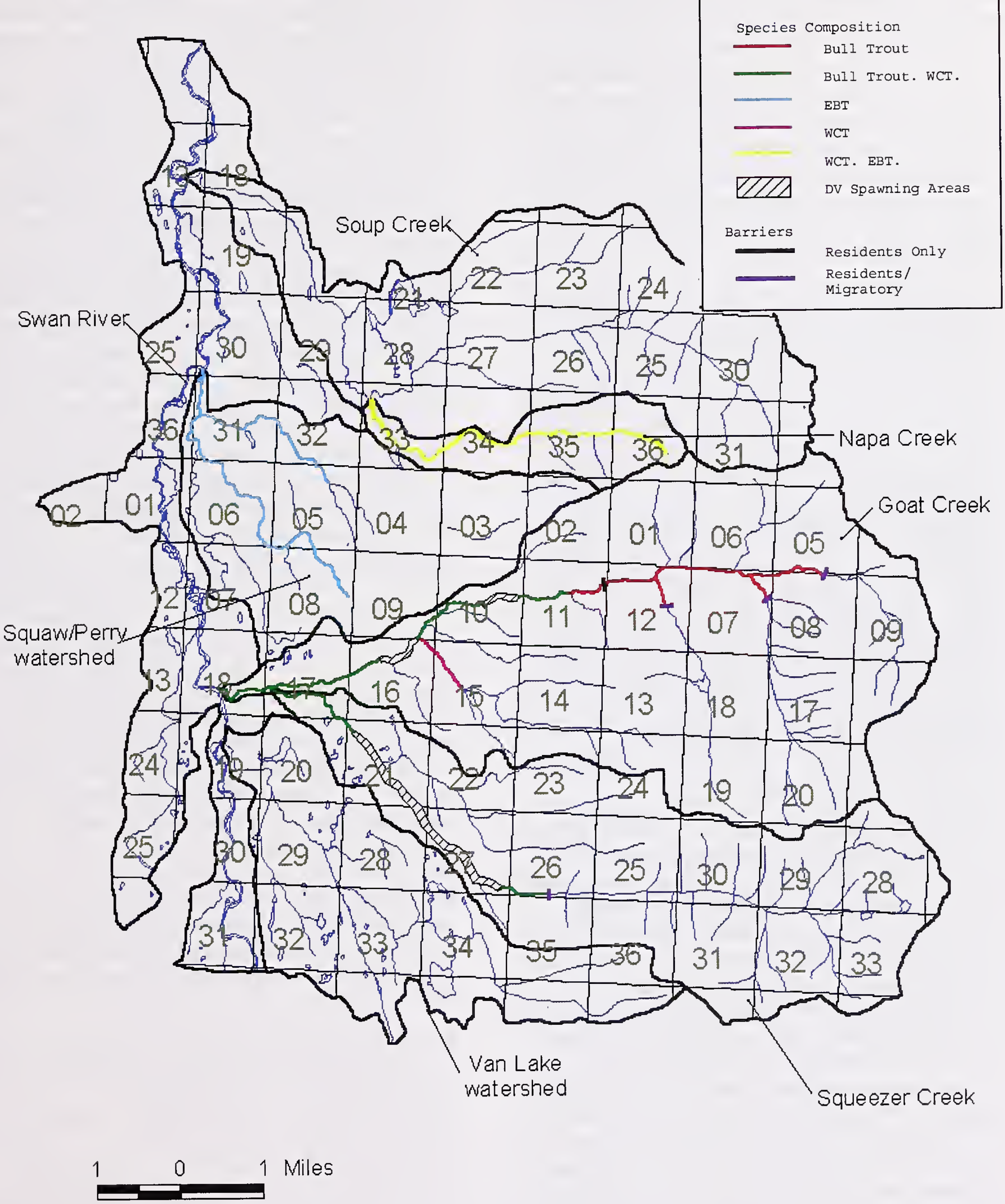
- Resident - resides and reproduces in natal stream.
- Fluvial - outmigrates to Swan River from its natal stream as a juvenile to sexually mature in the river, and returns to natal stream to spawn.
- Adfluvial - outmigrates to Swan Lake as a juvenile to sexually mature and returns to natal stream to spawn.

TABLE E-2 - GENERAL TIME FRAME OF LIFE HISTORY CHARACTERISTICS OF BULL TROUT AND WESTSLOPE CUTTHROAT OF THE ANALYSIS AREA

SPECIES:	BULL TROUT	WESTSLOPE CUTTHROAT
Spawning	September through early October	Late April through May
Egg incubation	September through January	May through June
Fry emergence	April through May	June through July
Rearing time (age of fish at outmigration)	1+ juveniles	Young-of-year and 1+ juveniles
Migrational spawning movement	July through August	March through April

Historically, fish passage between Flathead Lake and the Flathead River system with the Swan drainage was accessible. However, according to the *Montana Bull Trout Scientific Group (1996)*, construction of Bigfork Dam in 1902 blocked upstream access from Flathead Lake to the Swan drainage. A fish ladder was constructed in the 1920s to enable migratory fish to pass over the 12-foot high concrete diversion dam and access the Swan River drainage, but apparently the ladder did not work well. This ladder did not become fully operational until upgrades were made in 1959 *(Domrose, 1974)*.

FIGURE E-1 - SALMONID SPECIES COMPOSITION, DISTRIBUTION, AND PASSAGE BARRIERS OF THE ANALYSIS AREA.



However, the fish ladder was subsequently disabled in the late 1980s due to concern over the potential for introduced species, primarily lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupefomis*), to migrate upstream from the Flathead drainage into the Swan drainage *(Montana Bull Trout Scientific Group, 1996)*. As a result, the Bigfork Dam barrier has created a partial disruption to the historical upstream movement of bull trout. Fish are still able to migrate downstream.

As a result, the migratory (adfluvial) population from Swan Lake is now the dominant bull trout life-history pattern in the Swan drainage. According to the *Montana Bull Trout Scientific Group (1998)*, migratory bull trout can move great distances (up to 250 kilometers [155 miles]) among lakes, rivers, and tributary streams in response to spawning, rearing, and adult habitat needs. According to *Leathe and Enk, 1985*, one spawning bull trout tagged in Goat Creek moved downstream through Swan Lake, over Bigfork Dam, into Flathead Lake, and then was recaptured 9 months later approximately 34 miles up the Flathead River. The extent of this movement was 74 miles.

Genetic research has indicated there is a degree of introgressive hybridization between bull trout and brook trout in the Goat-Squeezer drainage. *Kanda (1998)* reported an F1 hybrid (first generation offspring of a bull trout-brook trout mating) in Goat Creek. In Squeezer Creek, *Kitano et al (1994)* observed a small male brook trout releasing sperm by sneaking into a redd during the spawning by a pair of large bull trout. In addition, *Kanda (1998)* found that F1 fish were not necessarily sterile, as previous research has suggested, but capable of backcrossing with either a bull trout or brook trout parental stock. However, the reproductive success of these F2 fish appears to be minimal indicating these 2 species do not form hybrid swarms.

Other recent genetic research has also yielded important information about pure bull trout populations. *Kanda and Allendorf (2001)* indicated that the large population differentiation that they detected within drainages suggests that little gene flow has occurred among bull trout populations, even over short geographic distances, and that geographically close populations have been highly isolated reproductively. Parallel to this, some of the genetic differentiation among populations may have evolved through adaptation to local environments *(Fox 1993; Phillipp and Clauson 1995; in Kanda and Allendorf, 2001)*. In addition, available data indicate that, at times, year classes of bull trout may be produced from a small number of spawners *(Kanda, 1998)*.

ANALYSIS METHODS

The methodology used to assess existing conditions included the evaluation of trout populations and their physical habitat. Physical habitat is broken into 4 main headings: sediment, woody debris, stream temperature, and fish passage. These physical-habitat headings are analyzed for both existing conditions (no-action alternative) and the action alternatives. Discussion of the habitat requirements for salmonids under the 4 main physical habitat headings is addressed under the Goat Creek data.

Scout Creek and Bethal Creek, tributaries to Goat Creek, have been identified in the *EXISTING CONDITIONS* section of this report to provide additional baseline knowledge of salmonid populations near the analysis area. However, these 2 streams are not analyzed in the *ALTERNATIVE EFFECTS* section of this report because they are both found upstream of any harvest tracts

contained in the proposed action alternatives. Potential impacts as a result of a particular action alternative would be evaluated through ongoing monitoring of fish populations, including redd counts, habitat-quality monitoring, and identification of risk factors to habitat degradation.

POPULATIONS

Fish populations have been sampled in select streams of the analysis area by DFWP, primarily through electroshocking. One-pass presence/ absence and relative abundance efforts have been completed to provide cursory information about fish populations. Two- to 3-pass depletion estimates, or mark-recapture techniques, have been employed to obtain population estimates. Redd counts have also been completed by DFWP in select streams of the analysis area to provide information about spawner escapement, actual redd construction, and relative recruitment.

PHYSICAL HABITAT

Physical habitat information for the analysis area has been primarily obtained from the following 3 studies, listed in chronological order: *Leathe et. al (1985)*, *Plum Creek (1996)*, and *Hauer, Gangemi and Baxter (1997)*. The Montana River Information System has also provided summary information for the analysis area. Ongoing monitoring data from DFWP for the Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program *(Flathead Basin Commission, 1991)* is also included. Data supplied to DNRC by *Land and Water (2002)* has been used to identify sediment sources in the Goat and Squeezer drainages. In addition, a report by *Ellis et al. (1999)* addresses the influences of forest harvests on water quality, especially relating to phosphorous, nitrogen, and total-suspended-sediment issues in the Goat Creek drainage.

Data from the *Plum Creek (1996)* study utilized the Level 2 methodology of the *Washington Forest Practices Board (1995), Version 3.0* for the watershed analysis of the Goat Creek (including Squeezer Creek) drainage and can be referenced for all physical habitat variables. The *Plum Creek (1996)* report should be referenced for a more detailed analysis of habitat conditions overlaid with geomorphic characteristics. The stream reaches near the proposed action areas are, generally, represented in *TABLE E–4 – PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK; TABLE E–5 – GOAT CREEK PHYSICAL HABITAT CHARACTERISTIC SCORING; TABLE E–14 SPECIFIC PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK;* and *TABLE E–15 – PHYSICAL HABITAT CHARACTERISTIC SCORING FOR SQUEEZER CREEK* (located further on in this appendix) for reaches G2 to G7 on Goat Creek and reaches S1.1 to S8 on Squeezer Creek, although some downstream and upstream reaches are included for baseline information. The numbering sequence follows a downstream to upstream relationship.

Sediment

Fine sediment in the analysis area has been evaluated by substrate scores and/or McNeil coring. A substrate score is an ocular assessment of streambed particle size and the relative degree of embeddedness. Embeddedness refers to the degree of armour, or the tight consolidation of substrate. A higher substrate score indicates more favorable fisheries-habitat conditions. Low substrate scores indicate smaller streambed particles and greater embeddedness, which constitutes poorer quality fish habitat. McNeil coring is a method used to determine the size range of material in streambed spawning sites. Results are given as a percentage of material less than

6.35 millimeters (1/4 inch) and indicate the quality of spawning and incubation habitat. The smaller the percentage of fine materials, the better the habitat condition. According to the *Flathead Basin Commission (1991)* cooperative report, a stream is considered threatened if the substrate score is less than 10 or the McNeil core is over 35 percent. Red-flag, or "impaired" values, are assigned to substrate scores less than 9 or McNeil core values over 40 percent.

Woody Debris

Woody debris in the Goat-Squeezer drainage has been described by 2 studies: *Hauer, Gangemi and Baxter (1997)* and the *Plum Creek (1996)* inventory. In the study by *Hauer, Gangemi and Baxter (1997)*, Coal Creek was 1 of 8 streams with reaches analyzed in third- and fourth-order segments as known bull trout tributaries. Three stream reaches on Goat Creek 100 meters in length were analyzed for large woody debris greater than 10 centimeters (approximately 4 inches) in diameter and greater than 1 meter in length.

Stream Temperature

Stream temperature data, where available, have been collected either by DNRC or DFWP continuous recorders or by spot temperature readings during the other field investigations completed by DNRC or DFWP. The anticipated effects to stream temperature will be addressed through removal of riparian vegetation.

Fish Passage

Fish passage has been determined through observations from the field investigation process of the many different studies conducted in the analysis area.

ANALYSIS AREA

The Goat Creek watershed, located 40 miles southeast of Kalispell, Montana, drains 13,280 acres west from the Swan Mountain Range into Swan River. Squeezer Creek, a tributary to Goat Creek, drains 8,995 acres on the southern half of the Goat Creek watershed. The Squaw Creek watershed, including the Perry Creek drainage, is 5,630 acres. These 2 predominately low-gradient tributaries are located just north of the Goat Creek watershed. Napa Creek, a 1,520-acre tributary to Soup Creek (8,265 acres), is also located just north of the Goat Creek watershed. The Van Lake watershed (5,525 acres), consisting of a series of wetlands, is located just south of the Squeezer Creek drainage. Van Lake consists of 58 surface acres.

EXISTING CONDITIONS

➢ *Goat Creek*

According to the *Montana Bull Trout Scientific Group (1996)*, Goat Creek is considered a core area for bull trout and is currently proposed as critical habitat by the USFWS. Core areas are drainages that historically and currently contain the strongest populations of bull trout and are important for spawning, rearing, and adult habitat needs. These habitats are key to the continued existence of bull trout in the Flathead Basin.

Populations

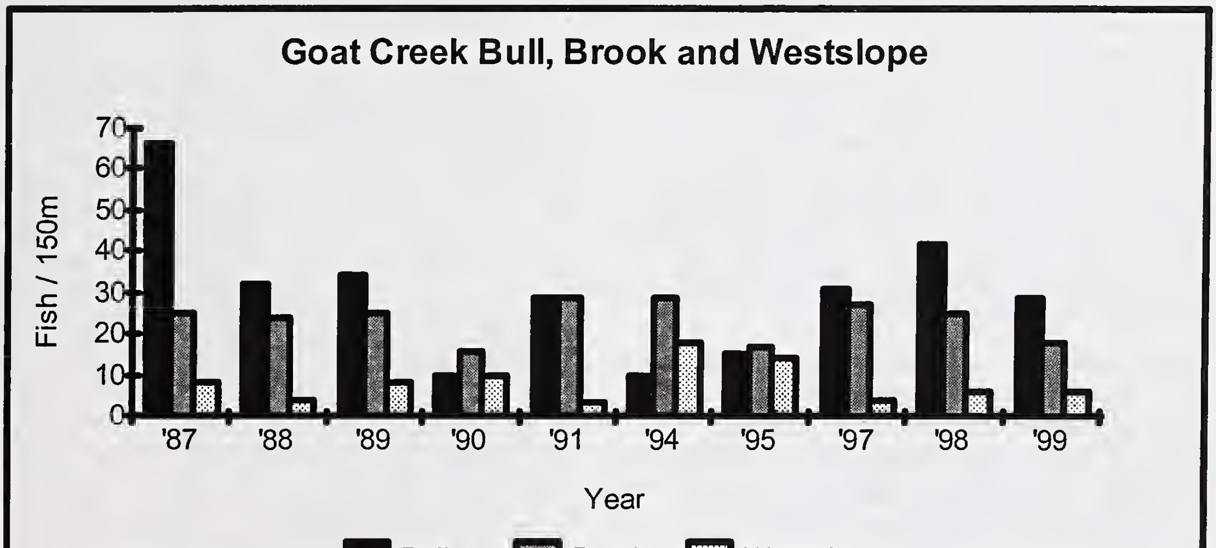
Population estimate data obtained from a 150-meter section on lower Goat Creek from 1987 to 1999 can be found in *FIGURE E-2 - GOAT CREEK BULL TROUT, BROOK TROUT AND WESTSLOPE CUTTHROAT TROUT POPULATION DATA*. Annual bull trout redd count trend data exists for Goat Creek with a period of record from 1982 to 2001 and can be found in *FIGURE E-3 - BULL TROUT REDD COUNT TREND DATA ON GOAT CREEK, 1982-2001*. Redd counts for westslope cutthroat trout are difficult to obtain due to high spring-flow conditions during and/or after spawning.

FIGURE E-2 - GOAT CREEK BULL TROUT, BROOK TROUT, AND WESTSLOPE CUTTHROAT TROUT POPULATION DATA shows a relatively stable species composition and population density in Goat Creek. Bull trout redd count data shown in *FIGURE E-3 - BULL TROUT REDD-COUNT TREND DATA ON GOAT CREEK, 1982 through 2001* indicates an increase in bull trout spawning in Goat Creek in recent years.

Salmonid populations in Goat Creek and the rest of the analysis area are subject to diverse pressures. One of these pressures includes the effects of timber harvesting.

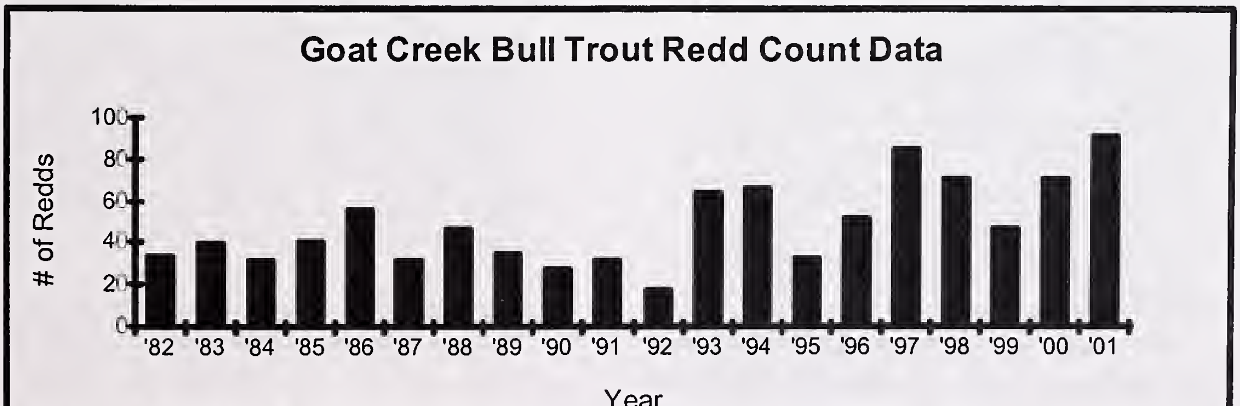
According to the *Montana Bull Trout Scientific Group (1995)*, past forestry practices (road construction, log skidding, riparian tree harvesting, clearcutting, splash dams) were often damaging to watershed conditions and are a major contributing cause of the decline of bull trout. The effects of these practices on habitat include increased sediment in streams, increased peak flows, hydrograph and thermal modifications, loss of in-stream woody debris and channel stability, and increased access to anglers and poachers.

FIGURE E-2 - GOAT CREEK BULL TROUT, BROOK TROUT, AND WESTSLOPE CUTTHROAT TROUT POPULATION DATA



Data from Rumsey (2001)

FIGURE E-3 - BULL TROUT REDD-COUNT TREND DATA ON GOAT CREEK, 1982 through 2001



Data from Montana Bull Trout Scientific Group (1996) and Rumsey (2001)

The *Montana Bull Trout Scientific Group (1996)* states that extensive logging and road construction began in the Swan drainage in the early 1950s. These activities, conducted on private, State, and Federal lands, have progressively penetrated most major tributary drainages upstream. The extent of timber harvesting and road development varies considerably within and between ownerships in the Swan drainage.

However, other human-caused sources within the Flathead Basin must also be assessed to better understand the population dynamics of bull trout and westslope cutthroat trout in the analysis area. This is due to the far-reaching migratory behavior of bull trout and, to a lesser extent, westslope cutthroat trout. For example, the construction of the Bigfork Dam eliminated approximately 15 percent of potential spawning and rearing habitat for the Flathead drainage bull trout population (*unpublished DFWP data in Montana Bull Trout Scientific Group, 1996*).

Other issues raised by the *Montana Bull Trout Restoration Team (1998)* in analyzing the relationship between land-management activities and habitat requirements of bull trout in the Flathead Basin include:

- residential and industrial development,
- mining,
- livestock grazing,
- agriculture,
- irrigation diversions,
- dams,
- secondary roads,
- recreation,
- transportation systems,
- fire management, and
- the introduction of nonnative species.

In the end, the *Montana Bull Trout Restoration Team (1996)* has raised the issue that more information on the unique characteristics of the Swan drainage is needed since the Swan drainage is the only drainage that the Scientific Group has evaluated where high levels of timber harvesting has occurred, high sediment loads are documented, brook trout are abundant, and yet bull trout numbers are increasing.

Physical Habitat

General characteristics of the physical in-stream habitat from the Montana River Information System for Goat Creek can be found in *TABLE E-3 - IN-STREAM PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK*. For additional baseline data from 1983 through 1984, *Leathe et al. (1985)* can be referenced.

TABLE E-3 - IN-STREAM PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK

REACH	MOUTH TO SQUEEZER CREEK (PERCENT)	SQUEEZER CREEK TO HEADWATERS (PERCENT)
River miles	0.0 to 0.7	0.7 to 9.7
Gradient	0.9	3.6
Pool ratio	(3)	(2)
Run ratio	(83)	(63)
Riffle ratio	(7)	(35)
Pocket ratio	(7)	(0)
Data obtained from Montana Rivers Information System website		

The most recent physical habitat analysis of the Goat Creek drainage was completed by *Plum Creek (1996)* and can be found in summarized format in *TABLE E-4 - PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK*. The parameters found in this table are assigned a scoring value found in *TABLE E-5 - GOAT CREEK PHYSICAL HABITAT CHARACTERISTIC SCORING*.

According to the *Montana Bull Trout Restoration Team (2000)*, bull trout have very strict

TABLE E-4 - PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK

HABITAT VARIABLE	REACH									
	G2	G3	G4	G5	G7	G8	G9	G10	G11	G36
Distance surveyed (m[1])	100	744	100	100	100	181	100	200	280	132
Percent canopy shade	31.7	44.1	44	46	58	89.6	53.75	76.1	53.6	73.7
Percent pool area	16.2	22.8	28.5	30.9	35.8	51.9	9.2	2.9	46.4	28.5
Number of pools	3	19	2	3	2	6	2	2	12	8
Channel width/pool	3.3	4	4.7	2.8	4.7	3	5.3	10.4	3.33	3.62
LWD/channel width	5.4	4.9	3.3	1.8	3.5	3.3	2.3	1.9	1.8	2.6
Percent of pools w/wood cover	100	84.2	100	66	50	100	0	0	83.3	75
Mean percent wood cover in pools	7.3	13.4	6	4	4	10.8	0	0	11.7	6.9
Percent boulder cover	2.7	2.5	0.8	0.2	60	33.6	53.7	58.9	1.8	39.6
Dominant substrate	Gravel	Cobble	Gravel	Cobble	Boulder	Boulder	Boulder	Boulder	Gravel	Boulder
Subdominant substrate	Cobble	Gravel	Cobble	Gravel	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble
Mean wetted width (m)	6.81	6.72	7.68	7.62	5.73	7.04	5.49	5.69	4.35	3.13
Mean channel width (m)	10.1	9.78	10.66	11.8	10.36	10.06	9.45	9.6	7.01	4.57
Mean wetted width pools (m)	7.11	6.94	7.92	7.82	6.1	8.23	4.57	5.03	4.17	3.31
Mean residual depth pools (m)	0.71	0.69	0.88	0.69	0.8	0.71	0.67	0.63	0.48	0.53
Mean residual depth pools w/wood (m)	0.71	0.68	0.88	0.63	0.96	0.71	N/A	N/A	0.49	0.6
Mean residual depth pools w/o wood (m)	N/A	0.74	N/A	0.81	0.63	N/A	0.67	0.63	0.48	0.32
Mean percent surface fines	12.2	12.8	19	23	16	5.45	26	8.54	10.7	5.7
Mean volume of LWD (cubic m)	N/A	0.47	0.3	N/A	0.85	0.27	0.64	0.56	0.69	0.41

Plum Creek (1996)
[1]meter = 39.37 inches
[2]LWD - large woody debris

habitat requirements that are generally referred to as the 4 Cs - clear, cold, complex, and connected. This includes clean, cold water; high levels of shade, undercut banks, and woody debris in streams; and connectivity among and between drainages. Bull trout also seem to prefer areas of gaining groundwater or groundwater up-welling reaches. The *Montana Bull Trout Scientific Group (1998)* states that the majority of migratory bull trout spawning in Montana occurs in a small percentage of the total stream habitat available. Spawning adults use low-gradient areas (less than 2 percent) of gravel/ cobble substrate. Proximity to

TABLE E-5 - GOAT CREEK PHYSICAL HABITAT CHARACTERISTIC SCORING

HABITAT VARIABLE	REACH									
	G2	G3	G4	G5	G7	G8	G9	G10	G11	G36
Summer/Winter Rearing:										
Percent pool	Poor	Poor	Poor	Fair	Fair	Good	Poor	Poor	Fair	Fair
Pool frequency	Fair	Fair	Poor	Fair	Poor	Fair	Poor	Poor	Fair	Fair
Debris pieces/ channel width	Good	Good	Good	Fair	Good	Good	Good	Fair	Fair	Good
Percent wood cover in pools	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Poor	Fair	Fair
Habitat condition call	Fair	Fair	Fair	Fair	Fair	Fair/ good	Poor	Poor	Fair	Fair
Winter Rearing:										
Substrate	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Poor	Good
Off-channel	Good	Good	Good	Fair	Fair	Poor	Poor	Poor	Fair	Poor
Habitat condition call	Fair/ good	Fair/ good	Fair/ good	Fair	Good	Fair	Fair	Fair	Poor/ fair	Fair
Upstream Adult Movement:										
Holding pools	Good	Good	Good	Fair	Good	Good	Poor	Poor	Fair	Good
Access to spawning	Good	Good	Good	Good	Good	Fair	Fair	Fair	Poor	Fair
Habitat condition call	Good	Good	Good	Fair/ good	Good	Fair/ good	Poor / fair	Fair / poor	Poor/ fair	Fair
Spawning and Incubation:										
Gravel quality	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair
Fines in gravel	Fair	Fair	Fair	Poor	Fair	Good	Poor	Good	Good	Good
Redd scour	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair
Gravel quantity	Fair		Fair	Fair	Good	Poor	Poor	Poor	Good	Poor
Habitat condition call	Fair	Fair	Fair	Fair	Fair/ good	Poor/ fair	Poor / fair	Fair	Good	Fair
Plum Creek (1996)										

cover for the adult fish (such as pool habitat with overhead protection) before and during spawning is an important habitat component. Actual redd construction often occurs in pool tail-out crests or low-gradient riffles. Juvenile fish utilize pocket-pool habitat and the interstitial spaces within the substrate for rearing cover are often found in close association with large woody debris.

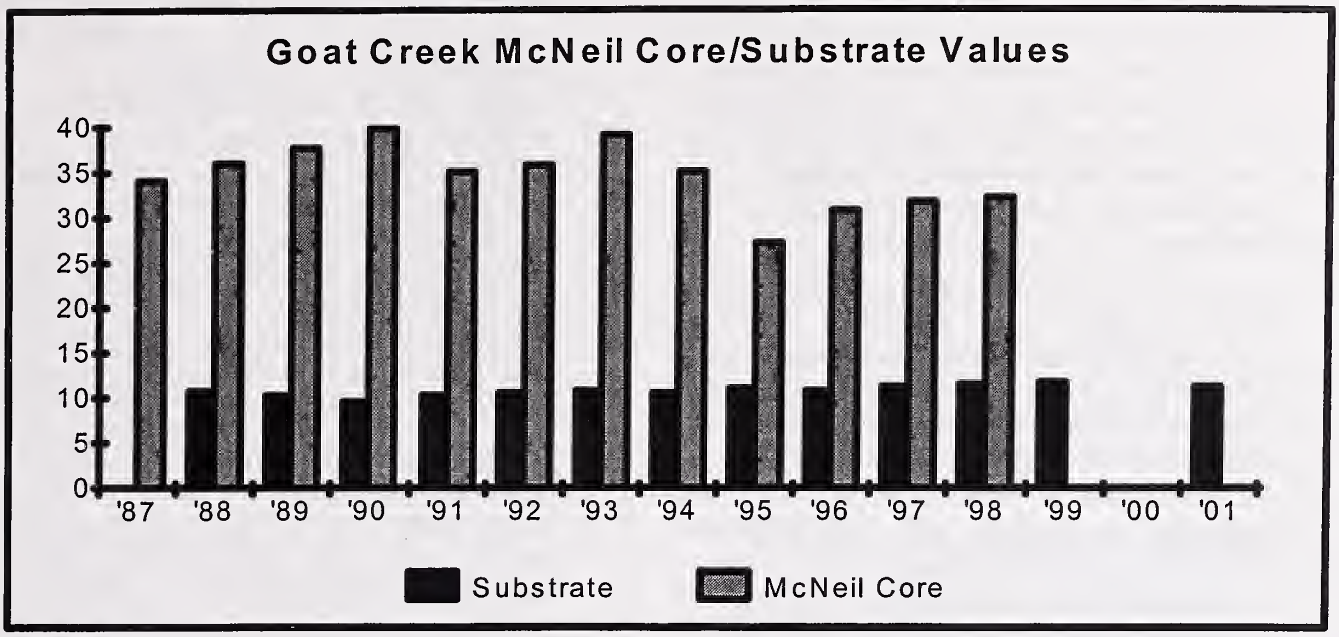
Specific to the Swan drainage, the *Montana Bull Trout Scientific Group (1996)* indicates that in Swan drainage surveys, bull trout were found to be most abundant in stream reaches having (1) gradients of 6 percent or less; (2) coarse, unembedded substrate material; and (3) summer maximum water temperatures of less than 16 Celsius (60 degrees Fahrenheit). Spawning by migratory fish occurred in tributaries with late summer flows exceeding 10 cubic feet per second *(Leathe and Enk, 1985)*.

Sediment

In 1978, DFWP began the *Flathead River Basin Monitoring Study* to develop baseline data for the Flathead River Basin and its tributaries. One of the tributaries sampled to develop index values through this effort is Goat Creek. Since 1987, DFWP has collected substrate scores and *McNeil cores* (see *ANALYSIS METHODS*) to analyze fine-sediment loading in the Goat Creek drainage.

McNeil coring trend data from 1987 through 2001 on Goat Creek indicate that out of the 12 years with data, no values were recorded above 40 percent and only 2 years had values from 35 to 40 percent. As shown in *FIGURE E-4 - GOAT CREEK SUBSTRATE SCORES AND MCNEIL*

FIGURE E-4 - GOAT CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1987 THROUGH 2001



No scoring in 2000 due to forest closures because of high fire dangers. Data from Rumsey (2001).

CORE VALUES, 1987 THROUGH 2001, for the 13 years with Substrate score data from 1988 to 2001, only 1 year had a score of less than 10 and no values less than 9 were recorded.

Heede et al., 1988; in Rinne 1990 states that human-induced watershed disturbances, like natural disturbances (e.g. wildfires, intense meteorological events), may increase the input of fine sediment beyond the capability of the stream to effectively discharge through transport by flushing flows. If extensive enough, ensuing substrate-fines buildup may reduce substrate interstices to a degree that negatively influences fish reproduction (*Hall and Lantz 1969; in Rinne 1990*) and food supply (*Bjornn et al. 1977; Alexander and Hansen, 1986; in Rinne 1990*).

According to *Rieman and Clayton (1997)* disturbance by fire, harvesting activities, and road construction invariably result in greater erosion and sediment production; however, the severity and longevity of increase is highly dependent on site properties and the kind of disturbance. Increased water and sediment yields can accelerate bank erosion of alluvial channels occupied by bull trout and cause mass wasting, bedload deposition, channel braiding, and overall channel instabilitity (*Montana Bull Trout Scientific Group, 1998*). According to *Meehan (1991)* accelerated surface erosion and mass wasting can increase the supply of coarse sediment and increase the frequency of debris torrents that could lead to blockage of fish migrations. For a more detailed analysis of water-yield issues, refer to *APPENDIX D—HYDROLOGY ANALYSIS*; for mass-wasting potential, refer to *APPENDIX G—SOILS ANALYSIS*.

Road construction causes the most severe disturbance to soils on slopes, far overshadowing fire and logging as a cause of accelerated erosion (*Swanson and Dyrness 1975; Beschta 1978; Reid and Dunne 1984 in Rieman and Clayton, 1997*). *Eaglin and Hubert (1993)* found

that trout standing stocks had a negative relation with the density of culverts, and erosion of soil from road surfaces, ditches, and disturbed areas adjacent to roads that, subsequently, is deposited in stream channels seems to be an important mechanism by which logging has affected stream habitat.

This is corroborated by *Swanson and Dyrness 1975; Beschta 1978; Reid and Dunne 1984 in Rieman and Clayton 1997*, who state that road construction causes the most severe disturbance to soils on slopes, far overshadowing fire and logging as a cause of accelerated erosion. According to *Ellis et al. (1999)*, an analysis of the FNF water-quality monitoring sites in 1997 indicated that as the road per miles per acre increased in the catchments, total phosphorus and particulate carbon concentrations in the monitored streams increased proportionately. The data also indicated that as the percent harvest increased, nitrate and nitrite nitrogen concentrations in these streams increased proportionately. For more information regarding sediment from roads, refer to APPENDIX D—*HYDROLOGY ANALYSIS*.

The results of high levels of fine-sediment accumulation to bull trout and westslope cutthroat trout populations can influence different life stages. According to the *Montana Bull Trout Scientific Group (1998)*, a substantial inverse relationship exists between the percentage of fine sediment in the incubation environment and bull trout survival to emergence. *Deleray et al. (1999)* state that redds become less suitable for incubating embryos if fine sediments and organic materials are deposited in interstitial spaces of the gravel during the incubation period. Fine particles impede movement of water through the gravel, thereby reducing delivery of dissolved oxygen to, and flushing of, metabolic wastes away from incubating embryos. *Weaver and Fraley (1991)* reported a significant negative correlation between brook trout embryo survival and later fry emergence and sediment fine content (less than 2.0 millimeter) in tributaries of the Flathead River. For juvenile bull trout, sediment accumulations reduce pool depth and fills in interstitial spaces of the substrate used for cover.

Whereas the potential for fine sediment effects to bull trout and westslope cutthroat trout do exist, the population data and McNeil coring/substrate data suggest that Goat Creek is not fine-sediment impaired.

Woody Debris

In a study by *Hauer, Gangemi and Baxter (1997)*, Goat Creek was 1 of 8 streams with reaches analyzed in third- and fourth-order segments as known bull trout tributaries. Three stream reaches (A, B, and C) on Goat Creek, 100m in length, were analyzed for large woody debris greater than 10 centimeter in diameter and greater than 1m in length. Reach A contained 2 channels, Reach B, 3 channels, and Reach C, 4 channels. Results are summarized in *TABLE E-6 - WOODY DEBRIS FREQUENCY IN GOAT CREEK*; *TABLE E-7 - WOODY DEBRIS DIAMETER CLASS AND ASSOCIATION WITH BANKS IN GOAT CREEK*; and *TABLE E-8 - DECAY CLASS OF LARGE WOODY DEBRIS IN GOAT CREEK*.

TABLE E-6 - WOODY DEBRIS FREQUENCY IN GOAT CREEK

REACH:	**A**	**B**	**C**
Frequency (number)	61	70	75
Volume (M3)	41.4	60.3	177.3
Attached	31	49	54
Unattached	30	21	21
Without rootwad	53	64	55
With rootwad	8	6	20
Hauer, Gangemi and Baxter (1997)			

TABLE E-7 - WOODY DEBRIS DIAMETER CLASS AND ASSOCIATION WITH BANKS IN GOAT CREEK

REACH:		A	B	C
No contact with banks (by diameter class)	1	11	19	11
	2	6	11	9
	3	3	4	3
	4	4	5	9
Contacting 1 bank (by diameter class)	1	10	12	7
	2	12	8	5
	3	3	1	6
	4	5	7	11
Contacting both banks (by diameter class)	1	0	0	2
	2	4	2	3
	3	1	0	1
	4	2	1	8
Diameter classes: 1 = 10-20 centimeters, 2 = 20-30 centimeters, 3 = 30-40 centimeters, 4 = 40-50 centimeters Hauer, Gangemi and Baxter (1997)				

TABLE E-8 - DECAY CLASS OF LARGE WOODY DEBRIS IN GOAT CREEK

REACH:		A	B	C
With bark and limbs (by diameter class)	1	5	12	6
	2	5	5	4
	3	0	0	2
	4	2	9	12
Surface rotted (by diameter class)	1	15	19	14
	2	13	13	13
	3	6	4	8
	4	8	4	13
Extensively rotted (by diameter class)	1	1	0	0
	2	4	3	0
	3	1	1	0
	4	1	0	3
Diameter classes: 1 = 10-20 centimeter, 2 = 20-30 centimeter, 3 = 30-40 centimeter, 4 = 40-50 centimeter Hauer, Gangemi and Baxter (1997)				

Woody debris is an essential component in forming pools and overhead cover for fish while diversifying channel dimensions. The factors that directly affect introduction, stability, or character of stream large woody debris have a potentially significant influence on native fish populations that utilize streams for spawning, rearing, or growth and completion of life histories *(Andrus et al. 1988; in Hauer, Gangemi and Baxter, 1997)*.

Hauer, Gangemi and Baxter, 1997 state from their study of large woody debris in the Flathead Basin that the implications for forest managers are 2-fold:

- With harvesting comes increased unpredictability in the frequency of size, attachment, and stability of the large woody debris.
- Riparian zones without harvesting may be essential to long-term maintenance of natural stream morphology and habitat features.

The data from *TABLE E-4 - PHYSICAL HABITAT CHARACTERISTICS OF GOAT CREEK*, *TABLE E-5 - GOAT CREEK PHYSICAL HABITAT CHARACTERISTIC SCORING*, and *TABLE E-8 - DECAY CLASS OF LARGE WOODY DEBRIS IN GOAT CREEK* indicate that Goat Creek has an adequate supply of in-channel woody debris to meet the different salmonid life-history needs and provide for in-stream channel complexity.

Stream Temperature

During a DNRC study from June 18 through October 15, 2001, an important time of the year for the bull trout life history, the highest daily stream temperature average recorded by a continuous recorder near the highway bridge was 11.4 Celsius. The lowest daily average was 3.3 Celsius. Instantaneous temperature readings indicated the highest temperature reading at 14.9 Celsius and the lowest instantaneous temperature at 1.4 Celsius.

Fraley and Shepard (1989) indicate that juvenile bull trout are very rare in streams with maximum summer water temperatures exceeding 15 Celsius and that adult migratory bull trout entered the tributaries when water temperatures dropped below 12 Celsius, and spawned from late

August through early October after temperatures dropped below 9 Celsius. The best survival of embryos is a temperature of around 4 Celsius (*Kanda, 1998*). Increases in water temperatures could have a detrimental effect on egg development and rearing success for both bull trout and westslope cutthroat trout.

A healthy riparian area provides stream shade needed to keep stream temperatures cool. According to *the Montana Bull Trout Scientific Group (1998)*, if riparian vegetation is removed, the effects include:

- increased summer and decreased winter water temperatures resulting from removal of shading and insulating vegetation;
- reduced large woody debris recruitment caused by removal of source vegetation;
- reduced pool quality, habitat complexity, channel stability, and bank stability arising from removal of vegetation and bank erosion; and
- reduced substrate quality by sediment delivery.

Fish Passage

Leathe et al. (1985) indicate that a 3-meter falls at km 8.5 on Goat Creek forms a barrier to upstream fish movement. This location is roughly 0.66 of a mile downstream of Scout Creek. Bull trout are found upstream of this location (see *FIGURE E-1 - SALMONID SPECIES COMPOSITION, DISTRIBUTION, AND PASSAGE BARRIERS OF THE ANALYSIS AREA*), and *Plum Creek (1996)* speculates that this is a barrier to upstream migration by westslope cutthroat trout, but not to larger, adfluvial trout. In addition, a barrier exists in Section 8 (see *FIGURE E-1 - SALMONID SPECIES COMPOSITION, DISTRIBUTION, AND PASSAGE BARRIERS OF THE ANALYSIS AREA*) near the headwaters that consists of 2 falls 3 meters and 12 meters in height and a cascade 4 meters in height. No fish are known to exist above this barrier.

➢ *Unnamed Tributary (Section 15)- Tributary to Goat Creek*

Populations

According to *Plum Creek (1996)*, a population of westslope cutthroat trout is reported to exist in this tributary.

Physical Habitat

The only physical habitat inventory of this tributary is from a qualitative assessment by *Plum Creek (1996)*. Geomorphically, this tributary is described as a **ground moraine intermittent**. Apparently, groundwater upwelling may play a role in keeping portions of this stream ice-free during the winter months, providing useable rearing habitat at this time of year.

Sediment

During field reconnaissance, *Plum Creek (1996)* reports that spawning gravels are available in limited quantities, but high concentrations of fine sediment indicate that incubation success is expected to be poor.

Woody Debris

No quantifiable in-channel woody debris volume data exists for this tributary. However, *Plum Creek (1996)* states that rearing habitat is provided primarily through dam pools formed by large woody debris obstructions and bedform.

Fish Passage

According to *Plum Creek (1996)*, migration barriers are evident through the intermittent flow patterns, suggesting that barriers to fish passage form at base flows.

➢ *Scout Creek- Tributary to Goat Creek*

Populations

No fish were sampled in this tributary during an electrofishing effort by *Leathe et al (1985)*. However, bull trout are suspected of utilizing the lower reach. According to *Plum Creek (1996)*, undesignated westslope cutthroat trout were planted in Scout Lake in 1969; their survival are unknown. *Rumsey (2001)* indicates that when Scout Lake was last net surveyed in 1968, no fish were collected, and that this lake might be too shallow to repeatedly over-winter trout.

Physical Habitat

Geomorphically, Scout Creek was characterized by *Plum Creek (1996)* as a glacial trough/incised mainstem. The only quantification of physical habitat parameters exists from a 1.5 kilometer analysis by *Leathe et. al (1985)* and is found in *TABLE E-9 - SELECT PHYSICAL HABITAT VALUES OF SCOUT CREEK*. Additionally, *Leathe et al (1985)* reported the stream was comprised of the following habitat types: 28 percent riffle, 13 percent run, and 59 percent pocket water/cascade.

Sediment

No McNeil core values or substrate scoring exists for Scout Creek. *Leathe et al (1985)* indicate the streambed was comprised of mainly cobble (42 percent) and boulder-bedrock (29 percent) with lesser amounts of large gravel (24 percent), small gravel (3 percent) and sand (2 percent). *Plum Creek (1996)* elaborates to suggest spawning habitat is limited due to sparse gravel availability. When spawning gravels were encountered, accumulations were in the few low-energy areas available, generally bars associated with large woody debris and boulder accumulations. Gravels were relatively free of fine sediments, but stability was judged to be relatively poor, suggesting redd scour is expected to impact embryo survival, especially for spring spawners.

Woody Debris

Leathe et al. (1985) indicate a moderate amount of instream cover (36 percent), which was mostly comprised of boulders and logs. *Plum Creek (1996)* states in their channel-type analysis that where large woody debris is present, pools tend to be more abundant. Large woody debris functions in jams and as individual pieces when large enough to be stable. Apart from the large woody debris recruitment and shade, riparian vegetation does not play a significant role in the maintenance or creation of available fish habitat (i.e. channel stability, undercut banks).

Stream Temperature

No stream temperature data exists for Scout Creek.

Fish Passage

A fish passage barrier exists at stream 0.6 kilometer, approximately. *Leathe et al. (1985)* indicate this barrier is formed by 2 cascades, 5 and 6 meters high. Also, during that study, the creek was dry from kilometer 1.5 to Scout Lake. These barriers, in addition to the average gradient found in *TABLE E-9 - SELECT PHYSICAL HABITAT VALUES OF SCOUT CREEK* and sediment data, suggest this stream has little value to recruitment.

TABLE E-9 - SELECT PHYSICAL HABITAT VALUES OF SCOUT CREEK

Stream/Habitat Value	Scout
Average gradient	20.3
Late summer flow (cubic feet per second)	2.7
Average wetted width (meter)	4.1
Pools (number/kilometer)	--
D-90 (centimeter)	74
Channel debris (percent)	86
Instream cover (percent)	36
Total overhead cover (percent)	69
Overhead cover (percent)	63
Leathe et. al (1985)	

➢ *Bethal Creek- Tributary to Goat Creek*

Populations

The lower portion of Bethal Creek is utilized by bull trout. According to *Leathe et al (1985)*, the reach was considered to be marginal for migratory bull trout production.

Physical Habitat

According to *Leathe et al. (1985)*, in the 3.0 kilometer reach analyzed, the stream was comprised of 15 percent riffle, 52 percent run, and 33 percent pocketwater-cascade. Other data from this study is found in *TABLE E-10 - SELECT PHYSICAL STREAM HABITAT VALUES FOR BETHAL CREEK*. Habitat values from the *Plum Creek (1996)* study are found in *TABLE E-11 - SELECT PHYSICAL STREAM-HABITAT VALUES FOR BETHAL CREEK* and are assessed a ranking in *TABLE E-12 - BETHAL CREEK PHYSICAL HABITAT CHARACTERISTIC SCORING*.

Sediment

No in-stream fine-sediment data exists from McNeil Coring or substrate scores on Bethal Creek. *Leathe et al (1985)* reported the stream was comprised mainly of boulder-bedrock (34 percent) and large gravel (27 percent) with lesser amounts of cobble (25

TABLE E-10 - SELECT PHYSICAL STREAM HABITAT VALUES FOR BETHAL CREEK

STREAM/HABITAT VALUE	BETHAL
Average gradient	9.9
Late summer flow (cubic feet per second)	3.8
Average wetted width (meter)	3.5
Pools (number/kilometer)	4.0
D-90 (centimeter)	39
Channel debris (percent)	35
Instream cover (percent)	11
Total overhead cover (percent)	40
Overhead cover (percent)	15
Leathe et. al (1985)	

TABLE E-11 - SELECT PHYSICAL STREAM-HABITAT VALUES FOR BETHAL CREEK (G20)

STREAM-HABITAT VALUES	G20
Distance surveyed (meter)	119
Percent canopy shade	82.7
Percent pool area	18.2
Number of pools	4
Channel width/pool	5.7
Large woody debris/channel width	3.7
Percent of pools w/wood cover	100
Mean percent wood cover in pools	18.2
Percent boulder cover	55.6
Dominant substrate	Boulder
Subdominant substrate	Cobble
Mean wetted width (meter)	4.06
Mean channel width (meter)	5.18
Mean wetted width pools (meter)	3.88
Mean residual depth pools (meter)	0.23
Mean residual depth pools w/wood (meter)	0.23
Mean residual depth pools w/o wood (meter)	N/A
Mean percent surface fines	10
Mean volume of large woody debris (cubic meter)	0.9
Plum Creek (1996)	

TABLE E-12 - BETHAL CREEK (G20) PHYSICAL HABITAT CHARACTERISTIC SCORING

HABITAT VARIABLE	G20
Summer/Winter Rearing:	
Percent pool	Poor
Pool frequency	Poor
Debris pieces/channel width	Good
% wood cover in pools	Fair
Habitat condition call	Fair
Winter Rearing:	
Substrate	Good
Off-channel	Poor
Habitat condition call	Fair
Upstream Adult Movement:	
Holding pools	Poor
Access to spawning	Poor
Habitat condition call	Poor
Spawning and Incubation:	
Gravel quality	Poor
Fines in gravel	Good
Redd scour	Poor
Gravel quantity	Poor
Habitat condition call	Poor
Plum Creek (1996)	

percent), small gravel (12 percent), and sand (2 percent). *Plum Creek (1996)* indicates that winter-rearing habitat is expected to be fair in this channel type because of the availability of deep pools and large substrate particles with interstitial spaces free of fine sediment.

Woody Debris

Beyond the *Plum Creek (1996)* data found in *TABLE E-10 - SELECT PHYSICAL STREAM HABITAT VALUES FOR BETHAL CREEK*, *Leathe et al.(1985)* report there was a low amount of instream cover (11 percent) that was mostly comprised of debris and turbulence.

Stream Temperature

During the *Leathe (1985)* study, the maximum temperature in Bethal Creek was 10.6 Celsius, which is in the acceptable range for both westslope cutthroat trout and bull trout.

Fish Passage

Leathe et al. (1985) indicate that there were numerous cascades from kilometer 0.5 to kilometer 1.0 that would likely prevent upstream movement of fish. This includes 2 cascade habitat units, at 4 and 7 meters in height.

➢ *Squeezer Creek*

Populations

Like Goat Creek, Squeezer Creek is considered a core area for bull trout by the *Montana Bull Trout Scientific Group (1996)* and is currently being proposed as critical habitat by USFWS. DFWP population-trend data exists periodically from 1987 and can be found in *FIGURE E-5 - SQUEEZER CREEK BULL TROUT AND BROOK TROUT POPULATION DATA*. Westslope cutthroat trout are present in Squeezer Creek; however, numbers are low enough to not yield a valid estimate. Rainbow trout have access to Squeezer Creek and are believed to inhabit this stream, yet no confirmation data exists. Redd counts have been completed on Squeezer Creek during the same time frame as Goat Creek and that trend data can be found in *FIGURE E-6 - BULL TROUT REDD COUNT TREND DATA ON SQUEEZER CREEK, 1982 THROUGH 2001*. Parallel to Goat Creek, there has been an increase in redds in recent years and population levels are relatively stable.

According to *Plum Creek (1996)*, westslope cutthroat trout were planted in Squeezer Lake in 1988 and 1992. The survival of fish planted in Squeezer Lake is unknown.

Physical Habitat

General characteristics of the physical in-stream habitat of Squeezer Creek from Montana Rivers Information System can be found in

FIGURE E-5 - SQUEEZER CREEK BULL TROUT AND BROOK TROUT POPULATION DATA

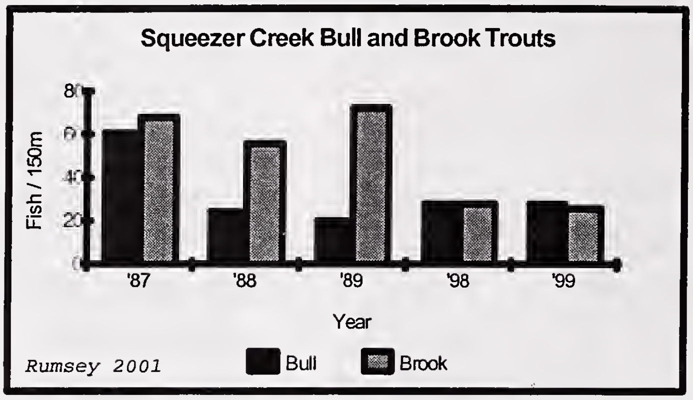
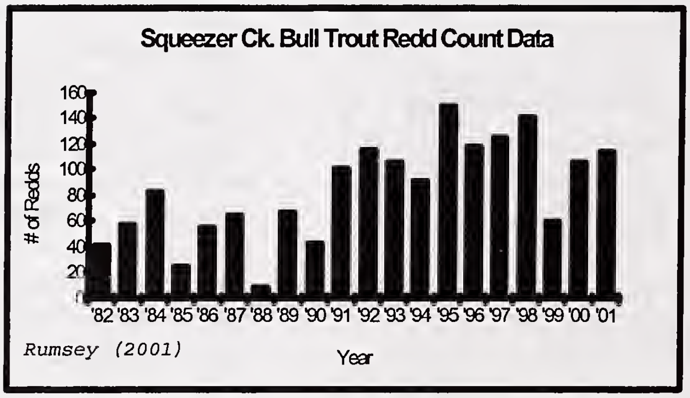
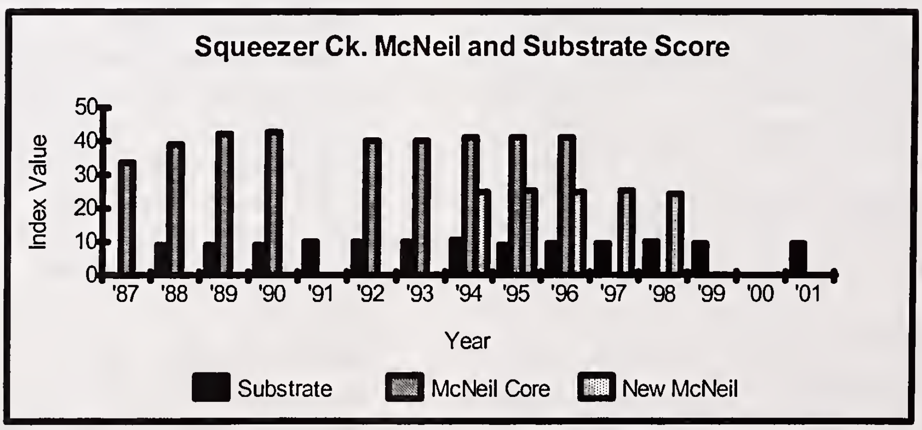


FIGURE E-6 - BULL TROUT REDD COUNT TREND DATA ON SQUEEZER CREEK, 1982 THROUGH 2001



**High flows may have obliterated some redds in 1988 and 1999.*
Data from Montana Bull Trout Scientific Group (1996) and Rumsey (2001)

FIGURE E-7 - SQUEEZER CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1987 THROUGH 1992



New McNeil station incorporated into study in 1994.
Data supplied to DNRC by DFWP.

TABLE E-13 - IN-STREAM PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK

REACH	RIVER MILES	GRADIENT	POOL RATIO	RUN RATIO	RIFFLE RATIO	POCKET RATIO
			PERCENT			
Mouth to headwaters	0.0 to 7.8	2.5	5	67	28	0 p
Data obtained from Montana Rivers Information System website						

TABLE E-13 - IN-STREAM PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK. For additional baseline data from 1983 through 1984, refer to *Leathe et al. (1985)*. *Squeezer* Creek was also analyzed during the *Plum Creek (1996)* study and values are reported in *TABLE E-14 - SPECIFIC PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK* and *TABLE E-15 - PHYSICAL HABITAT CHARACTERISTIC SCORING FOR SQUEEZER CREEK*.

Sediment

Data from 11 years of McNeil core sampling on Squeezer Creek indicate that 5 McNeil values were above 40 percent and 2 fell within 35 to 40 percent, with the remainder below 35 percent. Of the 13 years with substrate data, 11 years had values below 10 with 0 scores below 9. These values indicate that Squeezer Creek is more fine-sediment impaired than Goat Creek.

Woody Debris

No in-channel woody-debris data exists for Squeezer Creek from the *Hauer, Gangemi and Baxter (1997)* study. Refer to information on woody debris from *Plum Creek (1996)* found in *TABLE E-14 - SPECIFIC PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK*.

Stream Temperature

During a DNRC study from June 18, 2001 through October 15, 2001, an important time of the year for the bull trout life history, the

TABLE E-14 - SPECIFIC PHYSICAL HABITAT CHARACTERISTICS OF SQUEEZER CREEK

HABITAT VARIABLE	REACH					
	S1.1	S1.2	S2	S3	S6	S7
Distance surveyed (m)	200	261	453	282	247	125
Percent canopy shade	21.9	44.6	25.3	37.2	83.5	67.5
Percent pool area	44.2	31.1	68.5	54.7	26.1	43.2
Number of pools	9	14	23	17	8	14
Channel width/pool	3.85	3.5	2.53	2.4	4.71	1.47
Large woody debris/channel width	1.3	3	2	2.16	3.4	2
Percent of pools w/wood cover	89	85.7	95.6	94	100	71
Mean percent wood cover in pools	13.3	17.1	25.7	27.9	14.1	2.8
Percent boulder cover	13.1	12.4	0.03	0.41	19.2	64.1
Dominant substrate	Cobble	Cobble	Gravel	Gravel	Cobble	Boulder
Subdominant substrate	Gravel	Gravel	Sand	Cobble-Sand	Boulder	Cobble
Mean wetted width (m)	3.55	3.85	4.69	3.77	3.75	4.2
Mean channel width (m)	5.79	5.33	7.77	6.91	6.55	6.1
Mean wetted width pools (m)	3.42	3.81	4.94	3.91	4.46	4.1
Mean residual depth pools (m)	0.37	0.31	0.59	0.48	0.4	0.39
Mean residual depth pools w/wood (m)	0.37	0.31	0.6	0.48	0.4	0.38
Mean residual depth pools w/o wood (m)	0.38	0.27	0.53	0.41	N/A	0.43
Mean percent surface fines	11.9	18.4	37.4	29.2	8.3	4.9
Mean volume of large woody debris (cubic m)	0.5	0.23	0.18	N/A	0.35	0.65
Plum Creek (1996)						

TABLE E-15 - PHYSICAL HABITAT CHARACTERISTIC SCORING FOR SQUEEZER CREEK

HABITAT VARIABLE	REACH					
	S1.1	S1.2	S2	S3	S6	S7
Summer/Winter Rearing:						
Percent pool	Poor	Poor	Poor	Fair	Fair	Good
Pool frequency	Fair	Fair	Poor	Fair	Poor	Fair
Debris pieces/channel width	Good	Good	Good	Fair	Good	Good
Percent wood cover in pools	Fair	Fair	Fair	Poor	Poor	Fair
Habitat condition call	Fair	Fair	Fair	Fair	Fair	Fair/ good
Winter Rearing:						
Substrate	Fair	Fair	Fair	Fair	Good	Good
Off-channel	Good	Good	Good	Fair	Fair	Poor
Habitat condition call	Fair/good	Fair/good	Fair/good	Fair	Good	Fair
Upstream Adult Movement:						
Holding pools	Good	Good	Good	Fair	Good	Good
Access to spawning	Good	Good	Good	Good	Good	Fair
Habitat condition call	Good	Good	Good	Fair/ good	Good	Fair/good
Spawning and Incubation:						
Gravel quality	Good	Good	Good	Good	Good	Poor
Fines in gravel	Fair	Fair	Fair	Poor	Fair	Good
Redd scour	Fair	Fair	Fair	Fair	Fair	Fair
Gravel quantity	Fair		Fair	Fair	Good	Poor
Habitat condition call	Fair	Fair	Fair	Fair	Fair/ good	Poor / fair
Plum Creek (1996)						

highest daily stream temperature average recorded by a continuous recorder near the confluence with Goat Creek was 11.4 Celsius. The lowest daily average was 3.5 Celsius. Instantaneous temperature readings indicated the highest temperature reading at 14.9 Celsius and the lowest instantaneous temperature at 3.5 Celsius. All of these recordings are acceptable for salmonid health.

Fish Passage

Between stream mile 4.8 and 5.03 on Squeezer Creek, a sequence of waterfalls and cascades precludes upstream movement of fish *(Plum Creek, 1996)*. Above this barrier, no fish have been found, either by snorkeling or electrofishing *(Leathe et.al., presence/absence electrofishing survey)*.

➢ *Squaw Creek and Perry Creek*

Populations

According to *Rumsey (2001)*, during a recent presence/absence electrofishing survey of Squaw and Perry creeks, only brook trout were found to exist in this stream.

Physical Habitat

No physical habitat data has been collected on this stream at this time.

Sediment

McNeil coring and substrate scores are generally completed on bull trout and/or westslope cutthroat trout streams.

Woody Debris

No data has been collected at this time. Due to time and funding constraints, DNRC has focused on

bull trout and westslope cutthroat trout streams as a priority.

Stream Temperature

No data has been collected at this time. See explanation under *Woody Debris*.

Fish Passage

No fish passage problems were identified.

➢ *Napa Creek*

Populations

According to *Rumsey (2001)*, Napa Creek, a tributary to Soup Creek, was found to obtain a population of brook trout and, potentially, westslope cutthroat trout.

Physical Habitat

No physical habitat data has been collected on this stream at this time.

Sediment

McNeil coring and substrate scores are generally completed on bull trout and/or westslope cutthroat trout streams. A series of ponds exist near the confluence with Soup Creek that serve as effective sediment-filtering areas.

Woody Debris

No data has been collected at this time. Due to time and funding constraints, DNRC has focused on bull trout and westslope cutthroat trout streams as a priority.

Stream Temperature

No data has been collected at this time. See explanation under *Woody Debris*.

Fish Passage

Fish passage into and out of Napa Creek is seasonal with high flows. During spring, passage is available from Soup Creek into the ponds at the mouth of Napa Creek. As the stream level drops, fish passage is likely limited.

➢ *Van Lake*

Populations

According to *Rumsey (2001)*, Van Lake has been managed as an important fishery by DFWP since 1938. Historically, the lake was probably fishless and DFWP began a stocking program in 1938. Westslope cutthroat trout were originally stocked and, in later years, rainbow trout were stocked because they were more readily available. Presently the lake receives 5,000 rainbow trout annually. It is regarded as a put-grow-and-take fishery because little or no reproduction occurs due to the lack of an inlet or outlet stream. Redside shiners (*Richardsonius balteatus*) also exist in the lake and a robust zooplankton community combine to collectively provide a good forage base. Trout growth rates are good and Van Lake has a reputation as a very popular angling lake. Based on DFWP Statewide creel surveys done by mail, pressure estimates range from 510 to 1,373 angler-days annually for the recent period of 1989 through 1999. Compared to nearly 400 waters in DFWP's Region 1, Van Lake angler popularity has ranked as high as 40.

Physical Habitat

Van Lake has a surface area of 58 acres with a maximum depth of 37 feet. The Van Lake watershed is drained by a series of intermittent creeks and ephemeral draws.

Woody Debris

Due to the intermittent and ephemeral nature of the channels in the Van Lake watershed, no data on woody debris has been collected.

Stream Temperature

Due to the intermittent and ephemeral nature of the channels

in the Van Lake watershed, no data on stream temperature has been collected.

Fish Passage

Due to the intermittent and ephemeral nature of the channels in the Van Lake watershed, fish passage is not possible.

➢ *Swan River*

Swan River is considered nodal habitat for bull trout and is proposed as critical habitat by USFWS. Nodal habitats are waters that provide migratory corridors, overwintering areas, or other habitat critical to the population at some point during the fishes' life history (*Montana Bull Trout Scientific Group, 1996*).

Populations

A population estimate was conducted from Fatty Creek bridge downstream to the Point Pleasant Campground (nearest section to proposed action areas) by DFWP in 1990; 107(+/-57) rainbow trout and 50(+/-39) brook trout were found. Westslope cutthroat trout and mountain whitefish were also sampled, but estimates were not obtained. This species composition is consistent with other population estimates conducted on various sections of Swan River in the 1990s.

Physical Habitat

Little physical habitat for Swan River exists, especially as comparable to the data found for the streams of the proposed action area.

Sediment

No McNeil cores have been collected for Swan River within the project area. McNeil cores are collected in spawning habitat. Swan River in the project area is considered migratory and rearing habitat for bull trout.

Woody Debris

No quantitative data on woody debris in Swan River has been collected by DNRC.

Stream Temperature

DFWP's 2001 stream-temperature data at Fatty Creek bridge during August and September indicate a maximum temperature of 69.5 Fahrenheit and a minimum of 51.1 Fahrenheit. Recordings at the Porcupine Creek bridge during the same time frame indicate a maximum temperature of 65 Fahrenheit and a minimum temperature of 52 Fahrenheit. These maximum temperatures would be stressful to both westslope cutthroat trout and bull trout.

Fish Passage

No fish passage problems were identified in the project area. Roads crossing the river use bridges that do not present physical barriers.

DESCRIPTION OF ALTERNATIVES

- ***Description of No-Action Alternative A***

  No-Action Alternative A would not involve timber harvesting and associated activities.

- ***Description of Action Alternative B***

  Action Alternative B would include the following activities:

  - harvesting that would include stands defined as old growth;
  - 47.7 miles of road would receive minor to moderate road maintenance to improve BMPs;
  - 3.3 miles of road would be reconstructed to improve BMPs;
  - 2.9 miles of permanent new road and 1.1 miles of temporary road would be constructed following BMPs;
  - approximately 13.4 MMBF of timber would be harvested;
  - approximately 2,018 acres would be harvested by conventional ground techniques;
  - approximately 426 acres would be

harvested by cable techniques; and
- at the completion of harvesting activities, a percentage of the newly constructed roads would be gated or obliterated (see *APPENDIX F – WILDLIFE ANALYSIS* for details).

- ***Description of Action Alternative C***

Action Alternative C would include the following activities:

- harvesting that would not include stands defined as old growth;
- 33.6 miles of road would receive minor to moderate road maintenance to improve BMPs;
- 3.3 miles of road would be reconstructed to improve BMPs;
- 1.0 miles of permanent new road and 0.7 miles of temporary road would be constructed following BMPs;
- approximately 10.2 MMBF of timber would be harvested;
- approximately 1,538 acres would be harvested by conventional ground techniques;
- approximately 328 acres would be harvested by cable techniques, and
- at the completion of harvesting activities, a percentage of the newly constructed roads would be gated or obliterated (see *APPENDIX F – WILDLIFE ANALYSIS* for details).

DESCRIPTION OF DNRC SMZ AND SEDIMENT MITIGATION COMMON TO ACTION ALTERNATIVES B AND C

SMZ

Under Action Alternatives B and C, a DNRC-mitigated SMZ would include a 165-foot no-harvest zone on perennial streams. An 83-foot no-harvest zone would be applied to intermittent streams.

Prior studies demonstrate that SMZs minimize damage to habitat and effectively maintain the integrity of fish populations. In a study of how logging activities affect the wintertime stream environment for salmonids, *Heifetz et al. (1986)* found that buffer strips protected winter habitat of juvenile salmonids by maintaining pool area and cover within pools. In some cases, blowdown from buffer strips added large organic debris to the stream and increased the cover within pools. In addition, timber harvesting from streamside areas can increase incident solar radiation, decrease the large woody debris supply that reduces protection from peak flows, and decrease hydraulic complexity.

Meehan (1991) expands on the importance of streamside management as a tool to protect fishery values through demonstrated studies that have compared fish habitat and salmonid populations in streams that were and were not given riparian protection during timber harvesting. The evidence shows that SMZs minimize damage to habitat and effectively maintain the integrity of fish populations. This evidence is generally consistent over a wide span of time and space.

SEDIMENT MITIGATION

Under Action Alternative B or C, DNRC would mitigate sediment sources, identified by *Land and Water (2002)*, that occur in the action area, along with other mitigation measures. These include the following:

➢ ***Goat Creek***

- Temporary silt fences would be installed at 2 USFS locations during the period of harvesting operations.

- Drainage features/cross drains would be installed at 1 State site that currently contributes 0.22469 tons of sediment per year.

➢ ***Squeezer Creek***

- Drain dips or well casings would be installed at 2 sites on State

land that currently contribute a combined total of 0.5 tons of sediment per year.

- Improperly functioning culverts would be replaced at 3 locations on State land that currently contribute a combined total of 4.3 tons of sediment per year.

For both action alternatives, no culverts would be placed on fish-bearing streams. Culverts placed on intermittent streams would follow guidelines set forth by DFWP through the 124 Permit process. All roads would be located and built following BMPs. The amount of road mileage for each action alternative has been kept to a minimum to reduce effects to fish and wildlife.

Following logging operations, reclamation would incorporate concepts to discourage future motorized use of the roads. Roads would be gated, or road segments near the beginning of the new temporary road systems would be reshaped to their natural contours and reclaimed for approximately 200 feet by grass seeding and strewing slash and debris. The reclamation of the remaining road would include a combination of:

- ripping or mechanically loosening the surface soils on the road,
- removing culverts that were installed,
- spreading forest debris along portions of the road, and
- allowing the surface to revegetate naturally.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A on Fisheries***

Populations

No-Action Alternative A would not involve harvesting activities. As a result, no direct effects to fish populations in the waters of the analysis area would occur. Direct effects would be limited to natural conditions.

Physical Habitat

Sediment

With no harvesting activities occurring, No-Action Alternative A would not influence the natural landscape process of sediment delivery to stream channels in the waters of the analysis area. Direct effects would be limited to natural conditions. Therefore, adverse direct effects to spawning gravel and juvenile rearing habitat are unlikely.

Woody Debris

No-Action Alternative A would not involve harvesting activities. As a result, no influence to the natural landscape processes associated with in-stream or recruitable woody debris would occur.

Stream Temperature

With no harvesting activities occurring, No-Action Alternative A would not influence the natural landscape processes associated with incident solar radiation, water-flow dynamics, and, subsequently, stream temperatures.

Fish Passage

With no harvesting activities occurring, No-Action Alternative A would not influence existing fish barriers or the formation of any new natural fish-passage barriers.

- ***Direct Effects Common to Action Alternatives B and C on Fisheries***

Populations

Action Alternatives B and C would have no direct effects on fish populations within the analysis area. Direct effects from limiting factors associated with the physical channel environment are considered under *Physical Habitat*, below.

Physical Habitat

Sediment

Action Alternatives B and C only include the construction and reconstruction of roads, which will follow BMP guidelines, to access harvest units, as identified in the *DESCRIPTION OF ALTERNATIVES*. Other improvements on existing roads will also follow BMP guidlelines. These alternatives do not include the installation of stream crossing on perennial streams. Through DNRC-mitigated SMZs, all proposed harvest units and associated road-building activities are located far enough from fish-bearing streams to not have a direct effect on fish health through the liberation of fine sediment from surface erosion or mass wasting.

Woody Debris

No trees would be harvested in the first 165 feet from the banks of fish-bearing streams under Action Alternatives B and C, based on the inclusion of DNRC-mitigated SMZs. As a result, large woody debris would be retained for future recruitment as natural events dictate, and no direct effect to fish populations would exist.

Stream Temperature

Action Alternatives B and C incorporate the previously described SMZs. As a result, no influence to the existing quality of riparian vegetation or streamside shading that would increase stream temperatures and directly affect fish populations of the analysis area would occur.

Fish Passage

Action Alternatives B and C only involve temporary short spur roads, and stream crossings are not installed on perennial streams; therefore, no direct effect to fish passage would occur.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A on Fisheries***

Populations

Harvesting activities would not occur under No-Action Alternative A; therefore, no indirect effects to fish populations in the waters of the analysis area would occur.

Physical Habitat

Sediment

With no harvesting activities occurring, No-Action Alternative A would not influence the natural landscape process of sediment delivery to stream channels in the waters of the analysis area.

Woody Debris

With no harvesting activities occurring, No-Action Alternative A would not influence the natural landscape processes associated with in-stream or recruitable woody debris.

Stream Temperature

With no harvesting activities occurring, No-Action Alternative A would not influence the natural landscape processes associated with the incident solar radiation, waterflow dynamics, and, subsequently, stream temperatures.

Fish Passage

With no harvesting activities occurring, No-Action Alternative A would not influence existing fish barriers or the formation of any new natural fish-passage barriers. In addition, no temporary road-building and associated activities would occur. Indirect effects would be limited to natural conditions.

- ***Indirect Effects Common to Action Alternatives B and C on Fisheries***

Populations

Indirect effects to fish populations could occur from specific physical habitat limiting factors (see *Physical Habitat*, below) under Action Alternatives B and C.

Physical Habitat

According to the *Montana Bull Trout Scientific Group (1998)*, the indirect effects of upland timber management on bull trout and their habitat may include reduced pool quality, habitat complexity, channel stability, and bank stability caused by increased peak flows (See *HYDROLOGIC ANALYSIS* for peak-flow evaluation).

Sediment

As stated under *EXISTING CONDITIONS*, road-building and harvesting activities could increase the delivery of sediment to stream channels. However, existing data on Goat Creek indicates sediment to be primarily below threshold values for McNeil and Substrate scores. In addition, bull trout redd numbers have increased in recent years. Sediment is at threshold values for Squeezer Creek, yet bull trout redd numbers are also increasing in that stream. Exact incubation success is unknown for both streams. Under Action Alternative B, potential indirect sediment sources could result from the construction of 4.0 miles of temporary and permanent roads and reconstruction of 3.3 miles of roads, including the installation of culverts. Under Action Alternative C potential sediment sources could result from construction of 1.8 miles of temporary and permanent roads, and reconstruction of 3.3 miles of roads, including the installation of culverts. However, with mitigation and design features for the roads that would be constructed for harvesting operations, the indirect effects of Action Alternatives B and C would be minimized. If either Action Alternatives B or C were implemented, indirect fine-sediment delivery to the stream channel and effects to the fisheries and fisheries habitat would be unlikely as a result of the following items:

- winter harvesting for certain harvest units;
- incorporation of expanded SMZs,
- following BMPs for road and harvesting activities,
- locating harvest units predominately away from floodplains,
- grass seeding disturbed areas; and
- the gentle or moderate slope angles of the proposed harvest units.

Woody Debris

Since no SMZ harvesting would be implemented under either action alternative, no indirect effects to woody debris recruitment would occur.

Stream Temperature

Riparian vegetation would be maintained along all streams in the project area. As a result, the likelihood of negative indirect impacts to stream temperatures is considered low.

Fish Passage

No indirect effects to fish passage were identified for either action alternative.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A on Fisheries***

Populations

No-Action Alternative A is not expected to influence the

cumulative effects of natural landscape processes and human-caused factors as they associate with trout populations.

Physical Habitat

Sediment

No-Action Alternative A would not influence the cumulative natural landscape processes, in addition to past and future land-use activities, as they relate to sediment input to stream channels.

Woody Debris

No-Action Alternative A would not influence the cumulative natural landscape processes, in addition to past and future land-use activities, related to in-stream and recruitable woody debris issues. Recruitable woody debris would be left standing to be incorporated into the stream as natural events dictate.

Stream Temperature

No-Action Alternative A would not influence the cumulative natural landscape processes, in addition to past and future land-use activities, related to stream-temperature issues.

Fish Passage

No-Action Alternative A would not influence the cumulative natural-landscape processes, in addition to past and future land-use activities, related to issues of fish-passage.

- ***Cumulative Effects Common to Action Alternatives B and C on Fisheries***

Populations

Cumulative limiting factors to the salmonid populations in the analysis area are associated with the physical habitat and are considered under *Physical Habitat*, below. In addition, native trout populations in the Flathead Basin, including those in the analysis area, would undergo continued land-use pressure effects from other human-caused factors.

Physical Habitat

Sediment

Under Action Alternatives B and C, harvesting activities would not likely result in additional cumulative fine-sediment delivery to the stream channels as a result of the following project mitigation measures:

- winter harvesting for certain harvest units;
- incorporation of expanded SMZs,
- following BMPs for road and harvesting activities,
- locating harvest units predominately away from stream channels,
- grass seeding disturbed areas, and
- the gentle or moderate slope angles of the proposed harvest units.

Woody Debris

As a result of the DNRC-designed SMZs and the location of harvest units predominately outside of wood-debris- recruitment areas (SMZs), no detrimental cumulative effects to in-stream woody debris or recruitable woody debris would likely result from implementation of Action Alternatives B and C.

Stream Temperature

Riparian vegetation along streams would not be altered under either action alternative. As a result, the risk of negative cumulative influence to stream temperatures is considered low.

Fish Passage

As a result of the DNRC-designed SMZs and the location of harvest units outside flood-prone areas, Action Alternatives B and C would not likely result in detrimental cumulative effects to fish passage in the analysis area. Nor would these action alternatives likely

affect migratory connectedness with other waters needed for bull trout and westslope cutthroat trout to complete life-history patterns.

Wildlife

APPENDIX F

WILDLIFE

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX F

WILDLIFE ANALYSIS

INTRODUCTION

The discussion in this section pertains to wildlife species and their habitat in the existing environment and changes to that environment due to each alternative.

During the initial scoping and subsequent newsletter comments, the following issues were expressed regarding the effects of the proposed project:

- Timber harvesting might reduce biodiversity in the Swan Valley.

  DNRC uses a coarse-filter approach when assessing effects of proposed actions on biodiversity. DNRC assumes that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape. The main components of DNRC's coarse-filter assessment are stand covertypes, age classes, patch sizes and interior habitats, and connectivity. These components are described within the wildlife and vegetative sections of this document.

- Timber-harvesting activities might disrupt grizzly bear and other wildlife movements.

- Road construction/use might reduce habitat security for wildlife species such as grizzly bears, Canada lynx, pileated woodpeckers, goshawks, pine martens, and fishers.

  Goshawks and pine martens are not considered to be threatened, endangered, or sensitive species. General effects to each of their habitats are covered in the coarse-filter analysis.

- Timber harvesting and road construction/use might result in habitat becoming fragmented, habitat being lost, and/or wildlife species becoming displaced.

- Timber harvesting might reduce large-diameter snags available to wildlife.

- Timber harvesting in Section 30 might affect the habitat of elk, deer, and grouse.

  Grouse are not considered to be a threatened, endangered or sensitive species. General effects to their habitat are covered in the coarse-filter analysis.

- Winter harvesting might cause big game to become

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concentrated, which could result in increased mortality.

- Winter harvesting near Highway 83 may result in increased road mortality.
- Timber harvesting would remove old-growth habitat, resulting in negative effects to old-growth associated species.

In addition to the above issues, the analyses below discusses other environmental effects of the alternatives to the wildlife resource.

This discussion occurs on 2 scales. The project area includes DNRC-managed lands within Sections 32, 33, and 34, T24N, R17W, and Sections 4, 8, 10, 16, 20, 22, 26, 28, 32, and 34, T23N, R17W (*FIGURE II-3 - PROJECT AREA MAP FOR ACTION ALTERNATIVE B*). Full descriptions of the project area and proposed harvest units are presented in *CHAPTER II - ALTERNATIVES*. The second scale relates to the surrounding landscape for assessing cumulative effects. This scale varies according to the species being discussed, but generally approximates the size of the home range of the species in question. Under each grouping or species heading, the description for the cumulative-effects analysis area will be discussed. In the cumulative-effects analysis area, prior State actions and foreseeable future actions were considered and discussed, along with current conditions on other ownerships. Species were dismissed from further analysis if habitat did not exist in the project area or would not be modified by any alternative.

METHODS

To assess the existing condition of the project area and the surrounding landscape, a variety of techniques were used. Field visits, scientific literature, data from the SLI and Montana Natural Heritage Program, aerial photography, consultations with other professionals, and professional judgment provided information for the following discussion and effects analysis. In the effects analysis, changes in the habitat quality and quantity from the existing conditions were evaluated and explained. Specialized methodologies are discussed under the species in which they apply.

COARSE-FILTER ASSESSMENT

DNRC recognizes that it is an impossible and unnecessary task to assess an affected environment or the effects of proposed actions on all wildlife species. We assume that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape (*DNRC 1996*). This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate "historic conditions" across a landscape. To compare present and historical conditions across the landscape, the analysis was conducted on the entire Swan River State Forest using SLI data (refer to *VEGETATION ANALYSIS*) and was compared to the historical assessment compiled for the Upper Flathead Climatic Section (*Losensky 1997*).

Covertypes

The vegetation analysis indicates that covertypes have changed over the past century. Fire suppression and timber harvesting over the last century influenced covertypes and structure of habitats on Swan River State Forest. Generally, the Swan River State Forest supports more moist (mixed conifer, western larch/ Douglas-fir, western white pine) and dry (ponderosa pine) covertypes and less cool habitat types (subalpine fir, lodgepole pine) than found on

average for the climatic type (*Losensky 1997*). These conditions are primarily due to the valley location of the Swan River State Forest. Therefore, species using moist and dry covertypes are presumably more likely to be found or be more abundant on Swan River State Forest than on average in the climatic section. Conversely, species using cool habitat types are presumably less likely to occur or occur in lower densities on Swan River State Forest due to the amount of habitat present. Areas that were once dominated by the western larch-Douglas-fir covertypes have converted to more mixed-conifer covertypes (*TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON SWAN RIVER STATE FOREST AND THE CLIMATIC SECTION*). Conversion to mixed-conifer covertypes usually consists of increasing tree densities, canopy coverage, and a proportion of shade-tolerant tree species. These changes presumably reduced the abundance of species using open, shade-intolerant forested habitat, while favoring species using dense, closed-canopy habitats.

Patch Size and Interior Habitats

Species that are hesitant to cross broad expanses without forest cover, or those that depend upon interior forest conditions, can be sensitive to the amount and spatial configuration of appropriate habitat. Therefore, patch size and juxtaposition can influence habitat quality and population dynamics for some species. Some species are adapted to thrive near patch edges, while others are adversely affected by the presence of edge or by the presence of other animals that prosper in edge habitats.

A "patch" is defined as a unit of habitat with broadly similar age and structural characteristics (primarily associated with forest or nonforest cover). For this analysis, forested habitats provided the basis for patch, interior-habitat, and edge-habitat analyses. Forested habitats were defined as stands greater than 40 years old (pole- to sawtimber-sized stands) with a canopy cover of 40 percent or more. For this analysis, the 100-acre patch size was considered the minimum effective patch size and is referred to as a large patch, while patches 5 to 100 acres in size are referred to as small patches (*TABLE F-2 - EXISTING FORESTED, INTERIOR, AND EDGE HABITAT IN THE PROJECT AREA AND ON SWAN RIVER STATE FOREST*).

Interior habitat is defined as an area that is not affected by the

TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON SWAN RIVER STATE FOREST AND THE CLIMATIC SECTION

COVERTYPE	PERCENT CLIMATIC SECTION (LOSENSKY 1997)	PERCENT OF SWAN RIVER STATE FOREST THAT IS "APPROPRIATE" COVERTYPE ACCORDING TO SLI DATA	PERCENT OF SWAN RIVER STATE FOREST THAT IS "CURRENT" COVERTYPE ACCORDING TO SLI DATA
Ponderosa pine	1	5	6
Douglas-fir	<1	1	1
Western larch/ Douglas-fir	28	40	19
Western white pine	1	25	9
Lodgepole pine	27	4	6
Mixed conifer (spruce-fir)	6	13	43
Subalpine fir	36	7	9
Wheat-fescue	Trace	0	0
Other types	Trace	5	7

TABLE F-2 - EXISTING FORESTED, INTERIOR, AND EDGE HABITAT IN THE PROJECT AREA AND ON SWAN RIVER STATE FOREST

ALTERNATIVE	FORESTED HABITAT (ACRES)	INTERIOR HABITAT (ACRES)	EDGE HABITAT (ACRES)	NUMBER OF LARGE PATCHES (MEDIAN SIZE IN ACRES)	NUMBER OF SMALL PATCHES (MEDIAN SIZE IN ACRES)
Project area	3,244	878	2,366	12 (235)*	33 (25)*
Swan River State Forest	24,524	11,695	12,829	29 (331)	51 (15)

* *Any patch that intersected the project area was included in the analysis.*

adjacent stand and retains similar climatic conditions. Conversely, edge is defined as the contact zone between 2 different types of habitat. For this analysis, the first 300 feet of a patch was considered edge habitat; the remaining patch was considered interior habitat (*TABLE F-2 - EXISTING FORESTED, INTERIOR, AND EDGE HABITAT IN THE PROJECT AREA AND ON SWAN RIVER STATE FOREST*).

Connectivity

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforested expanses. Stands that are pole-sized or greater with crown closure greater than 40 percent can be important for providing travel cover for forest-dwelling species. Across Swan River State Forest, some connectivity through stands of various ages and shapes exist. However, the checkerboard ownership pattern and past management have compromised connectivity to a degree due to harvest-unit design and road-system development. In the Goat Squeezer Timber Sale Project area, connectivity to adjacent ownerships is variable; however, no harvest units are proposed in key travel areas, such as saddles or near streams (*FIGURE F-1 – FORESTED HABITATS FOUND ON SWAN RIVER STATE FOREST*). See the *Canada Lynx* and *Fisher* analyses for additional details on connectivity and travel cover.

COARSE FILTER

Direct Effects to Coarse Filter

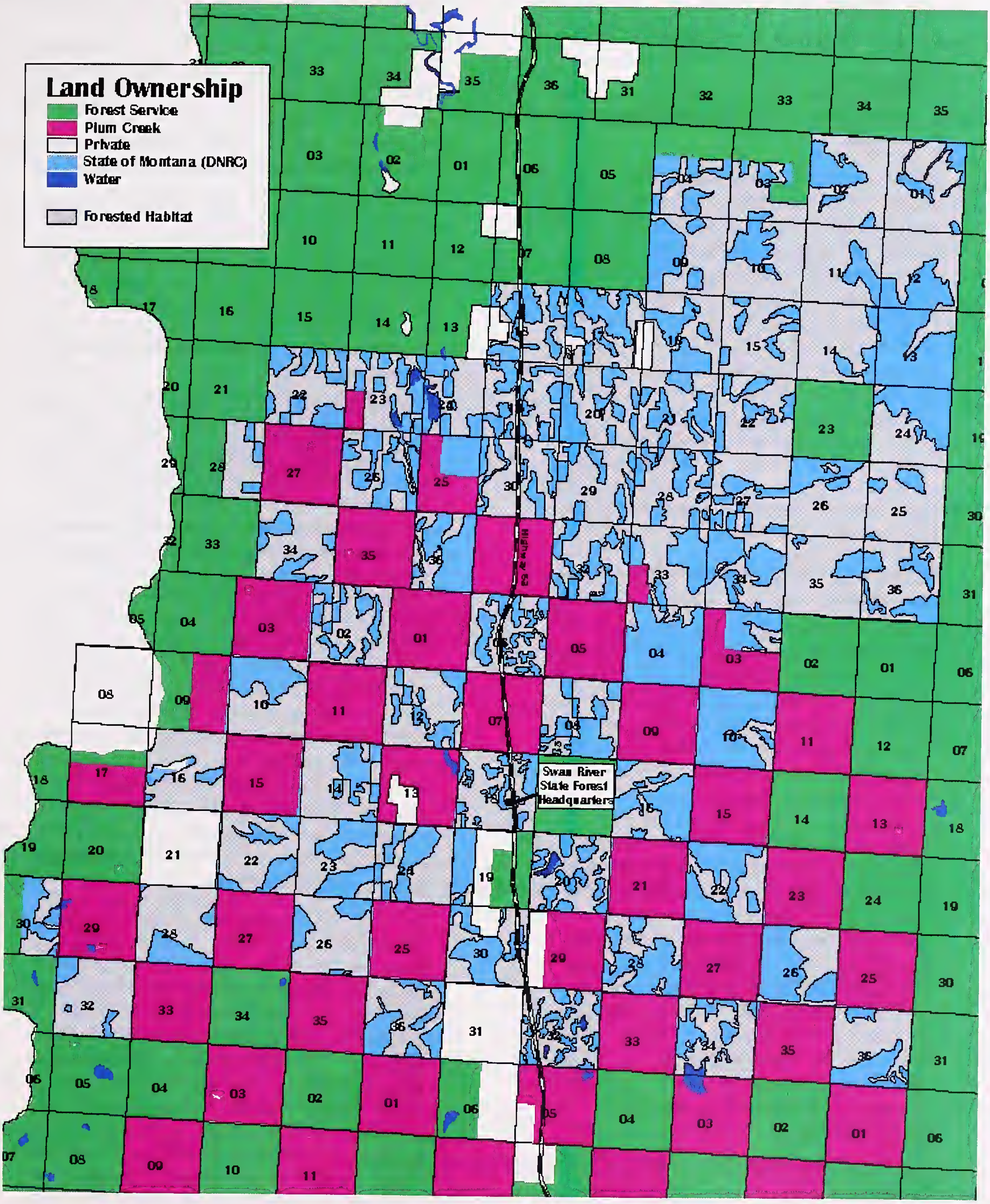
- ***Direct Effects of No-Action Alternative A to Coarse Filter***

  No additional displacement or disturbance of wildlife is expected in the area.

- ***Direct Effects of Action Alternatives B and C to Coarse Filter***

  Under Action Alternatives B and C, displacement and/or disturbance would be expected for wildlife species in the area. Since different species adapt to human disturbance differently, the extent of disruption would be related to the species in question. Generally, the amount of harvest area, associated roads, and duration of the project provides an avenue to develop a hierarchy of potential disturbance to wildlife in the area. Both action alternatives would be implemented in 2 to 3 contracts that could result in harvesting activities over a 3- to 5-year period. Action Alternative B proposes to harvest 13.4 MMBF of timber from 2,440 acres and construct 4.0 miles of new roads. Action Alternative C proposes to harvest 10.2 MMBF of timber from 1,866 acres and construct 1.8 miles of new roads. Due to the amount of acres, Action Alternative B is expected to take longer to complete than Action Alternative C. Therefore, Action Alternative B is expected to produce more disturbance to wildlife species and occur over a

FIGURE F-1— FORESTED HABITATS FOUND ON SWAN RIVER STATE FOREST



longer duration than Action Alternative C.

Indirect Effects - Coarse Filter

Covertypes

- ***Indirect Effects of No-Action Alternative A to Covertypes***

  Under No-Action Alternative A, the stands considered for harvesting would continue to age and convert to mixed-conifer covertypes. These stands would maintain or increase their canopy closure, shading out understory plants and shade-intolerant tree seedlings. In the long-term, species that use more-open stands and/or shade-intolerant tree species, would be negatively affected due to the loss of habitat, while species that use late-successional forest structure, would benefit by an increase in habitat.

- ***Indirect Effects of Action Alternative B to Covertypes***

  Under Action Alternative B, harvesting would convert Douglas-fir, lodgepole pine, and mixed-conifer covertypes to ponderosa pine, western larch/Douglas-fir, and western white pine covertypes. Other harvesting would maintain the existing covertype in ponderosa pine, Douglas-fir, mixed conifer, and western larch/ Douglas-fir, but would change stand composition (*VEGETATION ANALYSIS, TABLE C-1 - DIRECT EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVES B AND C*). These changes would favor wildlife species that use more-open canopies and shade-intolerant tree species at the expense of wildlife species associated with closed-canopy, shade-tolerant tree species.

  Action Alternative B would remove forested habitats for a long duration (10 to 80 years, depending on canopy removal and regeneration rates) through a regeneration harvest on 270 acres. In the short-term, early successional species would benefit from these harvests and the retention of snags and seedtrees. However, forest-dwelling species that rely on densely forested stand structures would lose habitat for a long duration until forested-habitat characteristics redeveloped in the stand (approximately 40 to 100 years). In the distant future, regeneration of shade-intolerant tree species would be available for species that use them.

- ***Indirect Effects of Action Alternative C to Covertypes***

  Under Action Alternative C, some harvesting would convert the Douglas-fir, lodgepole pine, and mixed conifer covertypes to ponderosa pine, western larch/ Douglas-fir, and western white pine covertypes. Other harvesting would maintain the existing covertype in ponderosa pine, Douglas-fir, mixed conifer, and western larch/Douglas-fir, but would change stand composition (*VEGETATION ANALYSIS, TABLE C-1 - DIRECT EFFECTS TO COVERTYPE ACREAGES BY ALTERNATIVES B AND C*). These changes would favor wildlife species that use more-open canopies and shade-intolerant species at the expense of wildlife species that use closed-canopy, shade-tolerant species.

  Action Alternative C would remove forested habitats for a long period of time (10 to 80 years, depending on canopy removal and regeneration rates) through regeneration harvesting on 233 acres. In the short-term, early successional species would benefit from these harvests and the retention of snags and seedtrees. However, forest-dwelling species that rely on a closed forest structure would lose habitat for a long period of time until these characteristics redeveloped in the stand. In the distant future,

regeneration of shade-intolerant tree species would be available for those species that use them.

Age Class

Patch Size and Interior and Edge Habitats

- ***Indirect Effects of No- Action Alternative A to Patch Size and Interior and Edge Habitats***

  Under No-Action Alternative A, patch size and interior and edge habitats would not change in the near term. Through time, forested patch size and interior habitat are expected to increase, while edge habitat would be expected to decrease. These conditions would favor wildlife species that prefer dense, mature forests at the expense of wildlife species that use nonforest, open-canopied, or edge habitats.

- ***Indirect Effects of Action Alternative B to Patch Size and Interior and Edge Habitats***

  This alternative would not reduce the number of large patches in the project area, but would reduce the median large patch size by 83 acres. Harvesting would reduce the number of small patches by 1 acre, while increasing the median patch size by 4 acres. This alternative reduces habitat for forest-interior wildlife species in some large patches; however, retaining the same number of larger patches of habitat lessens those effects.

  Under Action Alternative B, timber harvesting would reduce forested habitat by 643 acres, interior habitat by 354 acres, and edge habitat by 289 acres (*TABLE F-3 - EFFECTS OF EACH ACTION ALTERNATIVE ON FORESTED, INTERIOR, AND EDGE HABITATS, AND PATCH CHARACTERISTICS*). This Alternative would decrease habitat for species that use forested habitat, both interior and edge habitats, while favoring species that use open forests or nonforested habitats.

- ***Indirect Effects of Action Alternative C to Patch Size and Interior and Edge Habitats***

  This alternative would not reduce the number of large patches in the project area, but would reduce the median large patch size by 82 acres. Harvesting would reduce the number of small patches by 1 acre, while increasing the median patch size by 4 acres. This alternative reduces habitat for forest-interior wildlife species in some large patches; however, retaining the same number of larger patches of habitat lessens those effects.

  Under Action Alternative C, timber harvesting would reduce forested habitat by 473 acres, interior habitat by 225 acres, and edge habitat by 48 acres (*TABLE F-3— EFFECTS OF EACH ACTION ALTERNATIVE ON FORESTED, INTERIOR, AND EDGE HABITATS, AND PATCH CHARACTERISTICS IN THE PROJECT AREA*). This alternative would decrease habitat for species that use forested habitat, both

TABLE F-3 - EFFECTS OF EACH ACTION ALTERNATIVE ON FORESTED, INTERIOR, AND EDGE HABITAT, AND PATCH CHARACTERISTICS IN THE PROJECT AREA.

	ALTERNATIVE		
	A (PRESENT)	B (CHANGE)	C (CHANGE)
Acres of Forested habitat	3,244	-643	-473
Acres of Interior habitat	878	-354	-225
Acres of Edge habitat	2,366	-289	-248
Number of large patches (median acres)	12 (234)	-0 (151)	-0 (152)
Number of small patches (median acres)	11 (27)	-1 (31)	-1 (31)

interior and edge habitats, while favoring species that use open forests or nonforested habitats.

Connectivity

- ***Indirect Effects of No-Action Alternative A to Connectivity***

  Under this alternative, no change in forest connectivity is expected. Over time, forest connectivity would be expected to increase due to the succession of early seral stands and sparse stands. The increase in connectivity would benefit species that depend on dense interconnected forest by providing movement corridors and other habitats within the project area.

- ***Indirect Effects Common to Action Alternatives B and C to Connectivity***

  Timber harvesting under these alternatives does not substantially alter connectivity. Most of the forested stands affected generally occur at the edge of patches. Unit 17 in Section 10 splits a forested patch and could prevent travel from Goat Creek to the southeast portion of the section by wildlife species that require dense forested corridors for travel; this patch would be converted into 2 small patches. This is expected to result in minor effects to wildlife species using the area. A similar situation occurs with Unit 41 in Section 22; however, the retention of a no-harvest buffer along the tributary to Squeezer Creek could mitigate the effects of retaining a movement corridor between the forested patches.

- ***Indirect Effects of Action Alternative B to Connectivity***

  Units 46 and 47 in Section 26 could disrupt movement from Squeezer Creek into Section 26. This loss of connectivity is expected to result in reduced use of Section 26 by forest-dwelling wildlife species.

CUMULATIVE EFFECTS - COARSE FILTER

Covertype and Age Class

- ***Cumulative Effects of No-Action Alternative A to Covertype and Age Class***

  Under No-Action Alternative A, covertypes would continue to convert from shade-intolerant to shade-tolerant covertypes and stands in older age classes would continue to increase. This situation would affect wildlife species using the area by decreasing habitat diversity in the area and favoring species associated with late-succession, shade-intolerant tree species.

- ***Cumulative Effects Common to Action Alternatives B and C to Covertype and Age Class***

  Under Action Alternatives B and C, efforts would be made to convert stands to more closely reflect the historic conditions outlined in *Losensky (1997)*. Under Action Alternative B, conversion would occur through the thinning of shade-tolerant species and regeneration harvesting. The harvesting would result in more closely reflecting historic covertypes and age classes. This alternative would benefit early successional species at the expense of mid- to later-successional species. The treatments are expected to increase the growth of retained trees, thereby decreasing the amount of time before large trees are available in these stands. These alternatives are expected to benefit native wildlife species by reproducing habitats to which the species are adapted.

Patch Size, Interior and Edge Habitats, and Connectivity

Adjacent private ownerships are expected to continue to increase early seral habitats and increase

edge habitat, especially along DNRC ownership. These conditions could negatively influence connectivity and interior habitat in the near future. Conversely, adjacent USFS lands are not expected to be harvested, thereby increasing forested habitat and patch size in those areas. The effects discussed under the indirect effects above would be cumulative to the conditions occurring on adjacent lands in the area.

FINE FILTER

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species federally listed as threatened or endangered, species listed as sensitive by DNRC, and species managed as big game by DFWP. These species are addressed below.

Threatened and Endangered Species

- Bald Eagle

The bald eagle is classified as "threatened" and is protected under the Endangered Species Act. Strategies to protect the bald eagle are outlined in the *Pacific States Bald Eagle Recovery Plan (USFWS 1986)* and the *Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group, 1994)*. Management direction involves identifying and protecting nesting, feeding, perching, roosting, and wintering/migration areas *(USFWS 1986, Montana Bald Eagle Working Group, 1994)*.

Bald eagles prefer multistoried nesting habitats with 40- to 70-percent canopy cover, with emergent trees within topographic line-of-sight to an associated water source with an adequate food supply. The emergent trees and/or snags need to be large enough (more than 25 inches dbh) to support nesting or perching eagles. Additionally, eagles prefer cottonwood, Douglas-fir, and ponderosa pine trees *(Wright and Escano 1986)*. In western Montana, eagles also use western larch and Engelmann spruce.

Eagles use the project area during the winter to feed on winter-killed deer. Eagles appear to concentrate use in the highway corridor, but some feeding probably occurs in other portions of Swan Valley away from the highway. Timber harvesting along the highway could remove or reduce perches and roosts used by eagles scavenging on carrion.

The project area is not within any known bald eagle nesting territory and is 11 miles south of the nearest established nesting territory at the south end of Swan Lake. However, a nest is suspected to be on DNRC land north of Van Lake. Eagles have been spotted near the lake on several occasions. In late spring 2002, several immature eagles were documented at the lake. Later in the year, 2 adult eagles were seen at the north end of the lake in a tree with a broom or a nest. These observations occurred during a year of heavy spring fish kill and may only represent nonbreeding eagles concentrating on an abundant food source. Surveys will continue during the spring of 2003 and into the future. Additionally, the project appears to contain other potential nesting habitat. Any stand with more than 1 tree or snag larger than 21 inches dbh per acre and within 1 mile of Swan River was considered potential habitat, based on habitat parameters reported by *Wright and Escano (1986)*. By this definition, Units 9, 33, 36, 55, 58, 59, 60, 61, and 62 (383 acres) are considered potential nesting habitat. Other units that occur within 1 mile could provide suitable habitat in time. All units lie along Highway 83, except Units 9 and 36, substantially reducing the potential for bald eagle nesting. Timber harvests

could affect bald eagles and their habitat directly by road use and harvest disturbance, or indirectly by reducing visual screening, changing canopy coverage, and altering the number, species, and distribution of large snags and large trees.

To assess cumulative effects to bald eagles, 2 analysis areas were considered. The Swan River Analysis Area includes lands within 1 mile of Swan River, while the Van Lake Analysis Area encompasses lands within 1 mile of Van Lake (*FIGURE F-2—BALD EAGLE CUMULATIVE EFFECTS ANALYSIS AREA WITH PROPOSED HARVEST UNITS*). In the Swan River Analysis Area, approximately 11,632 acres of land exists within the cumulative-effects analysis area. Of that land, DNRC manages 6,198 acres, Plum Creek Timber Company manages 3,717 acres, and USFS manages 558 acres. The remaining 1,159 acres is privately owned. DNRC-managed land in the cumulative effects analysis area contains 1,663 acres of potential habitat. Presently, salvage harvesting, firewood cutting, and other disturbances associated with Highway 83 and other open roads affect the potential for bald eagle nesting. The Van Lake Analysis Area encompasses 1,298 acres of Plum Creek Timber Company land, 807 acres of USFS land, and 637 acres of DNRC lands, totaling 2,792 acres. On DNRC lands, approximately 308 acres provide structure that could support nesting eagles. Presently, disturbance associated with recreational uses of Van Lake, timber-harvesting activities on Plum Creek Timber Company lands, firewood harvesting, and open roads affect the potential for bald eagle nesting.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Bald Eagles***

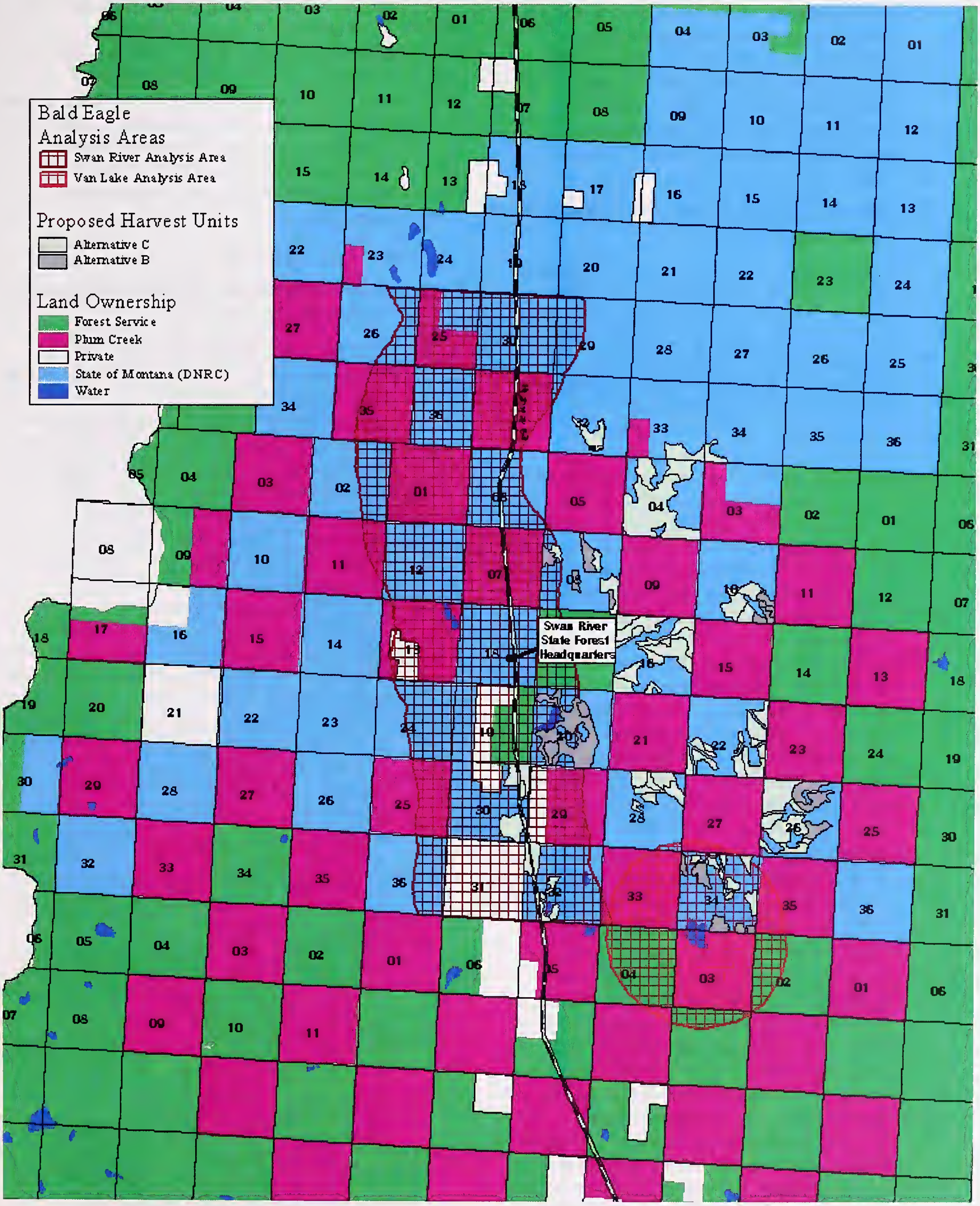
  No additional direct effects to nesting or wintering bald eagles would be expected.

- ***Direct Effects of Action Alternative B to Bald Eagles***

  Under this alternative, winter harvesting (November 16 through March 31) of Units 33, 36, 55, 58, 59, 60, 61, and 62 would occur. Unit 9 could be harvested in either the summer (June 16 through August 31) or winter (November 16 through March 31) period. It is unlikely that winter harvesting would appreciably affect eagle access to carrion, because the Highway 83 corridor provides large amounts of carrion during winter. The logging operations would affect approximately 2 miles of the Highway 83 corridor. The other portions of the corridor would not be affected and carrion is expected to be available. In the event carrion is available adjacent to harvest units, eagles could access the food source during periods of logging inactivity. Any decrease in access to carrion or increase in disturbance to feeding eagles is expected to be minor and not affect winter survivability.

  During the breeding season (late February through March), winter harvesting would continue, and disturbance in Units 33, 36, 55, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, and 72 could result in avoidance of potential nesting habitat. Bald eagle surveys would be conducted prior to commencement of harvesting activities in February or later in the nesting season. If a nesting territory is not present in the project area, no direct effects to nesting eagles would

FIGURE F-2 - BALD EAGLE CUMULATIVE EFFECTS ANALYSIS AREA WITH PROPOSED HARVEST UNITS



occur. If nesting behavior were observed or a nest were discovered within 1 mile of the project area, additional mitigation measures outlined in the *Habitat Management Guide for Bald Eagles in Northwestern Montana* (*Montana Bald Eagle Working Group 1991*) would be applied.

- ***Direct Effects of Action Alternative C to Bald Eagles***

  Under this alternative, winter harvesting (November 16 through March 31) of Units 33, 55, 58, 61, and 62 would occur. Unit 9 could be harvested in either the summer (June 16 through August 31) or winter (November 16 through March 31) period. Winter harvesting would not likely affect eagle access to carrion appreciably because the Highway 83 corridor provides large amounts of carrion during winter. The logging operations would affect approximately 2 miles of the Highway 83 corridor. The other portions of the corridor would not be affected and carrion is expected to be available. In the event carrion is available adjacent to a harvest unit, eagles could access the food source during periods of logging inactivity. Any decrease in access to carrion or increases in disturbance to feeding eagles would be expected to be minor and not affect winter survivability.

  During breeding season (late February through March), winter harvesting would continue and disturbance in Units 33, 36, 55, 58, 59, 60, 61, 62, 63, 64, and 70 could result in avoidance of potential nesting habitat. Bald eagle surveys would be conducted prior to commencing harvesting activities in February or later in the nesting season. If a nesting territory is not present in the project area, no direct effects to nesting eagles would occur. If nesting behavior were observed or a nest were discovered within 1 mile of the project area, additional mitigation measures outlined in the *Habitat Management Guide for Bald Eagles in Northwestern Montana* (*Montana Bald Eagle Working Group 1991*) would be applied.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Bald Eagles***

  Timber stands that presently provide bald eagle habitat would continue to increase in density and proportion of shade-tolerant tree species, while decreasing in growth rates. Additionally, snags would continue to develop. Over time, shade-tolerant nesting trees (Douglas-fir, Engelmann spruce, and subalpine fir) would replace shade-intolerant nesting trees (western larch, ponderosa pine). Barring any natural disturbance, shade-intolerant trees would not regenerate over time. Existing younger stands would continue to grow and produce the structure needed by eagles, but at a slower rate due to dense stocking. Under this alternative, eagle nesting-habitat quality would decrease as canopy cover increases above 70 percent (*Montana Bald Eagle Working Group 1991*). Additionally, eagle access to winter kill would be reduced due to the dense canopy. Big game carrion is expected to be maintained at the current level or increase (refer to *BIG GAME* section of this document), resulting in current or additional amounts of forage for wintering eagles. The potential of these effects limiting expansion of the breeding population is low.

- ***Indirect Effects of Action Alternative B to Bald Eagles***

Under this alternative, 383 acres of 1,663 acres of existing potential bald eagle nesting habitat on State lands would be affected in Units 9, 33, 36, 55, 58, 59, 60, 61, and 62 in the Swan River Analysis Area. In the Van Lake Analysis Area, 135 acres of existing potential bald eagle nesting habitat would be affected in Units 63, 64, 65, 67, 68, 69, 70, and 72. Canopy cover would be reduced from more than 70 percent to 40 to 60 percent in Units 9, 33, 36, 55, 58, 61, 65, 67, 69, and 72. In Units 59, 60, 62, 63, 64, and 70, canopy cover would be reduced to less than 40 percent. In Unit 68, canopy cover would be retained at greater than 70 percent. In Units 59, 60, and 62, canopy cover would be reduced to less than 40 percent. In all harvest units, all western larch and ponderosa pine snags larger than 21 inches dbh and farther than 200 feet from an open road would be retained. In the above units, only Units 59, 62, 65, 67, and 69 contain large western larch snags. Some loss of these snags could occur during harvesting or for safety reasons; however, this loss is expected to be minimal due to ground harvesting systems. In all the proposed harvest units, trees larger than 21 inches and 17 inches dbh occur. Harvesting would not reduce the number of live western larch and ponderosa pine greater than 21 inches dbh to less than 6 trees per acre and would, potentially, increase the vigor and growth rate of the retention trees, while decreasing their susceptibility to wildfire. Harvesting is expected to enhance potential habitat qualities by reducing canopy cover, while retaining large existing and future potential nesting trees (*Montana Bald Eagle Working Group 1991*). However, the disturbance associated with Highway 83 is expected to offset any beneficial changes in habitat quality in Units 33, 55, 58, 59, 60, 61, and 62. The recreational use in the Van Lake area could offset any beneficial habitat changes that occur due to harvesting in Units 63, 64, 65, 66, 67, 68, 69, 70, and 72.

This alternative would reduce canopy cover, while retaining multistoried stands, visual screening, tree vigor and growth, and large snags, which could improve the potential nesting habitat in Units 33, 55, 58, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69, 70, and 72. Improvement of existing stands would not be expected to result in additional nesting territories due to the disturbance associated with Highway 83 and Van Lake. Improved habitat in Units 9 and 36 (226 acres), which are further away from the highway, could increase bald eagle nesting habitat in the area; however, increased nesting populations are unlikely to result because Highway 83 is located between the nest and Swan River.

The reduction in thermal cover proposed under this alternative could decrease big game populations to some degree, resulting in a reduced amount of winter carrion for eagles in the long term. The extent of the effects of such decreases is unclear due to the large area of the Swan Valley winter range and the effects of weather patterns during recovery, but is expected to be negative. This alternative would be expected to result in minor negative effects to wintering bald eagles through decreased carrion sources.

Overall, this alternative would be expected to result in minor positive effects to breeding bald eagles, while resulting in minor negative effects to wintering bald eagles.

- ***Indirect Effects of Action Alternative C to Bald Eagles***

Under this alternative, 134 acres of existing potential bald eagle nesting habitat would be affected in Units 9, 55, 58, 61 and 62 in the Swan River Analysis Area. In the Van Lake Analysis Area, 68 acres of existing potential bald eagle nesting habitat would be affected in Units 64, 68, 69, and 70. Canopy cover would be reduced from more than 70 percent to 40 to 60 percent in Units 9, 55, 58, 61, and 69. In Units 60, 62, 64, and 70, canopy cover would be reduced to less than 40 percent. In Unit 68, canopy cover would be retained at greater than 70 percent. In all harvest units, all western larch and ponderosa pine snags larger than 21 inches dbh and farther than 200 feet from an open road would be retained. In the above units, only Units 62 and 69 contain large western larch snags. Some loss of these snags could occur during harvesting or for safety reasons; however, this loss would be expected to be minimal due to the use of ground harvest systems. In all the proposed harvest units, trees more than 21 inches and 17 inches dbh occur that could provide potential nest or perch trees. Harvesting would not reduce the number of live western larch and ponderosa pine larger than 21 inches dbh to less than 6 trees per acre and would, potentially, increase the vigor and growth rate of the retained trees, while decreasing their susceptibility to wildfire. Harvesting is expected to enhance potential habitat qualities by reducing canopy cover while retaining large existing and future potential nesting trees (*Montana Bald Eagle Working Group 1991*). However, the disturbance associated with Highway 83 would be expected to offset any beneficial changes in habitat quality in Units 33, 55, 58, 61, and 62. The recreational use in the Van Lake area could offset any changes that occur due to harvesting in Units 64, 68, 69, and 70.

Action Alternative C would reduce canopy cover while retaining multistoried stands, visual screening, tree vigor and growth, and large snags, which would improve potential bald eagle nesting habitat in Units 33, 55, 58, 61, 62, 64, 69, and 70. Improvement of existing stands would not be expected to result in additional nesting territories due to the disturbance associated with Highway 83. Improved habitat in Unit 9 (19 acres), which is further away from the highway, could increase bald eagle nesting habitat in the area; however, increased nesting populations would not be likely because Highway 83 is located between the nest and Swan River.

The reduction in thermal cover proposed under this alternative could decrease big game populations to some degree, resulting in a reduced amount of winter carrion for eagles in the long term. The extent of the effects of such decreases is unclear due to the large area of the Swan Valley winter range and the effects of weather patterns during recovery, but would be expected to be negative. This alternative would likely result in minor negative effects to

wintering bald eagles through decreased carrion sources.

Overall, this alternative would likely result in minor positive effects to breeding bald eagles, while resulting in minor negative effects to wintering bald eagles.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Bald Eagles***

  Under this alternative, no additional disturbance or habitat modification would occur in the analysis area. Presently, 1,961 acres of potential habitat exists on State lands in the cumulative effects area. The Small Squeezer Timber Sale enhanced habitat quality on 16 acres of this habitat, while salvage harvests removed perch sites on other areas. Small Squeezer II and the proposed South Wood timber sales do not affect potential eagle habitat. Harvesting on Plum Creek Timber Company lands in the analysis area increased access to carrion, but removed potential nesting habitat. The effects of this alternative would not affect access to forage or alter potential nesting habitat; therefore, eagle winter use is not anticipated to be affected.

- ***Cumulative Effects of Action Alternative B to Bald Eagles***

  This alternative would affect 518 acres of potential bald eagle nesting habitat in the Swan River Analysis Area. On 226 acres, habitat alteration could result in a benefit to potential nesting habitat. Combined with the Small Squeezer Timber Sale, bald eagle habitat on State lands in the cumulative effects area would improve on 242 acres. However, the disturbance associated with Highway 83 would reduce the benefits of these improvements. Harvesting on Plum Creek Timber Company lands in the analysis area removed additional potential nesting habitat. These improvements are expected to be minor and not result in appreciable increases in nesting potential.

  This alternative would affect 135 acres of potential eagle nesting habitat in the Van Lake Analysis Area. On 114 acres, habitat alteration could result in a benefit to potential nesting habitat. However, the disturbance associated with Van Lake could reduce the benefits of these improvements. Harvesting on Plum Creek Timber Company lands in the analysis area reduced potential nesting habitat, but increased access to carrion. Openings where carrion might be easily accessed across Swan Valley are likely to be relatively abundant for several decades. Any improvements are expected to be minor and not result in increased breeding populations.

- ***Cumulative Effects of Action Alternative C to Bald Eagles***

  This alternative would affect 202 acres of potential eagle nesting habitat in the Van Lake Analysis Area. On 19 acres, habitat alteration could result in a benefit to potential nesting habitat. Combined with the Small Squeezer Timber Sale, bald eagle habitat on State lands in the cumulative effects area would improve on 169 acres. However, the disturbance associated with Highway 83 would reduce the benefits of these improvements. Harvesting on Plum Creek Timber Company lands in the analysis area removed potential nesting habitat. Openings where carrion might be easily accessed across Swan

Valley are likely to be relatively abundant for several decades. Any improvements are expected to be minor and not result in increased breeding populations.

Canada Lynx

Canada lynx are listed as "threatened" under the Endangered Species Act. Currently, no recovery plan exists for Canada lynx. Several reports have been written to summarize the research on lynx and develop a conservation strategy (*Ruediger et al 2000*).

Lynx are associated with subalpine fir forests, generally between 4,000 to 7,000 feet in elevation, in western Montana (*Ruediger et al 2000*). Lynx habitat in western Montana consists primarily of young coniferous forest with plentiful snowshoe hares, stands with abundant coarse woody debris for denning and cover for kittens, and densely forested cover for travel and security. Additionally, the mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al 1977*). Lynx tracks and observations are relatively rare in Swan Valley, and radio-collared lynx in the Seeley Lake vicinity rarely venture north of the Clearwater/Swan River divide (*J. Squires, pers. comm., USFS, September 5, 2002*)

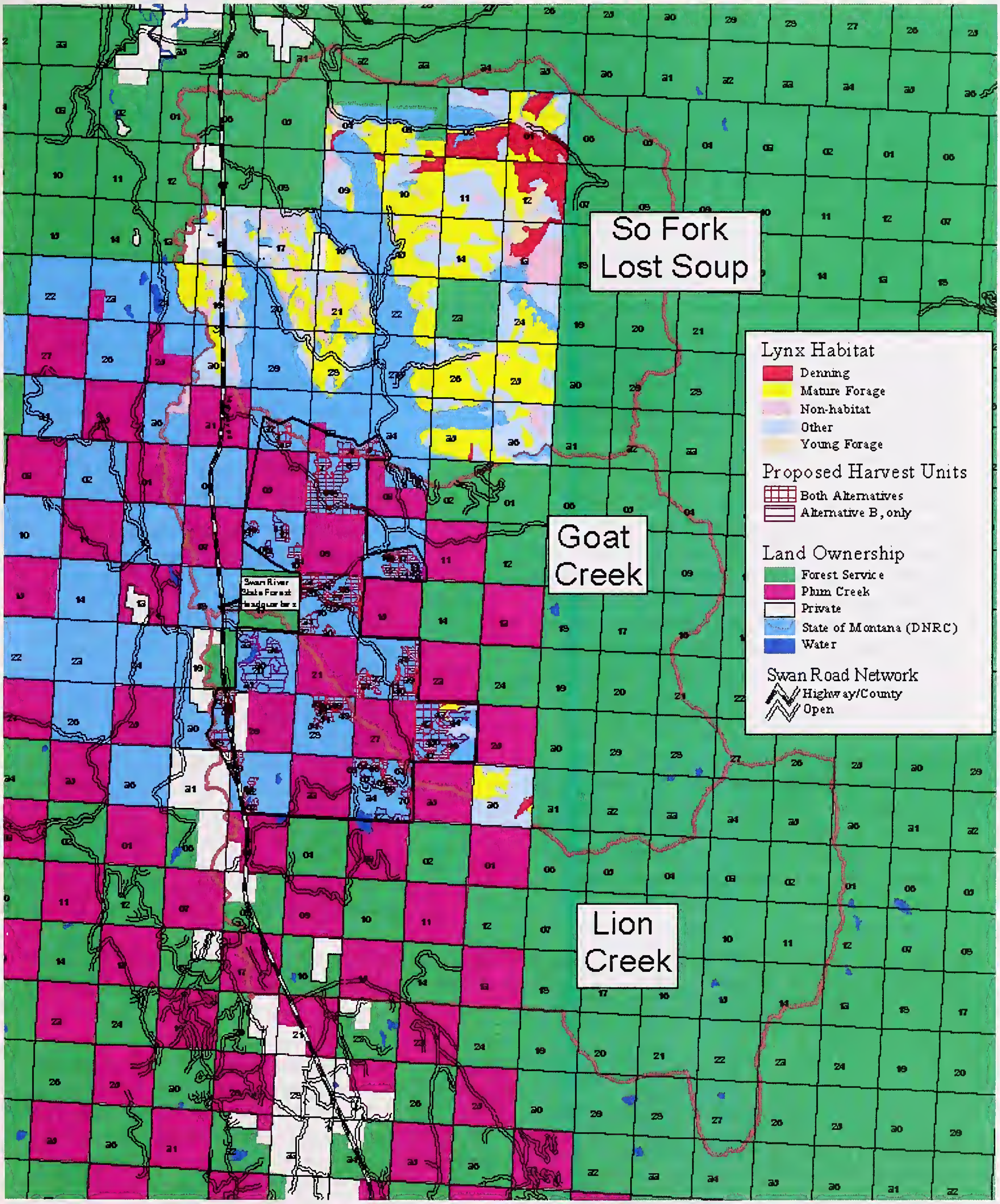
To assess lynx habitat, DNRC SLI data were used to map specific habitat classes used by lynx. These areas were considered *lynx habitat*. Any of these habitats located on ungulate winter ranges, as defined by DFWP, were removed from consideration of lynx habitat. Other parameters (stand age, canopy cover, amount of coarse woody debris) were used in modeling the availability of specific types of lynx habitat in the area (i.e. denning, forage, other, temporarily not available).

- *Young forage* consisted of regenerating stands less than 39 years old in a well-stocked condition (more than 1,500 trees per acre).
- *Mature forage* included all stands in lynx habitat greater than 40 years old with more than 40 percent canopy closure.
- *Denning* habitat consisted of mature stands (older than 100 years) with more than 40 percent canopy closure and a high abundance of coarse woody debris present.
- *Temporary nonhabitat* included all stands with regeneration less than 15 years old, stands that received precommercial thinning within 10 years, and stands with less than 40 percent canopy closure.
- *Other* habitat included any habitat of a suitable habitat type with more than 40 percent canopy cover that could be used by lynx for travel or any other purpose.

Based on the above analysis, lynx habitat comprised approximately 103 acres (1.0 percent) of habitat on State lands within the project area. Of these acres, 31 acres of mature foraging and 70 acres of other habitats exist in the project area. These areas are lower elevation and on warmer and drier sites than those typically used by lynx (*McKelvey 2000, Squires 2000*).

Cumulative effects were analyzed for lands in the Goat Creek, Lion Creek, and South Fork Lost Soup Grizzly Bear Subunits (*FIGURE F-3 - LYNX HABITAT PRESENT IN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SUBUNIT CUMULATIVE EFFECTS ANALYSIS AREA*). In the Goat Creek and Lion Creek

FIGURE F-3 — LYNX HABITAT PRESENT IN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SUBUNIT CUMULATIVE-EFFECTS ANALYSIS AREA



subunits, USFS manages the higher elevations, while DNRC and Plum Creek Timber Company manage the lower lands in and near the valley bottom, along with minor private land ownership. DNRC conducted several timber sales in the Goat Creek Subunit and salvage harvests in both subunits. Most of the corporate timberland in these subunits are currently temporary nonhabitat or young forage habitat. No projects aimed at modifying habitat on USFS lands are currently active. In the South Fork Lost Soup Subunit, USFS and DNRC manage the upper and lower elevations. In addition to this project, DNRC is planning a salvage harvest (Soup Creek Salvage 2002, 2003) in this subunit. No projects are currently active on USFS lands. *TABLE F-4 - SUITABLE AND UNSUITABLE LYNX HABITAT ACRES ON DNRC LANDS WITHIN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SOUP GRIZZLY BEAR SUBUNITS* shows the distribution of lynx habitats on DNRC lands in these 3 subunits.

Within the next 2 decades, *temporary nonhabitat* is expected to develop into *young forage* habitat on approximately 44 acres in the Goat Creek Subunit and 1,131 acres in the South Fork Lost Soup Subunit. During this same time period, *young forage* would develop into *mature forage* and *other* habitat on 573 acres in the South Fork Lost Soup Subunit. Salvage harvests in the past removed coarse woody debris needed for denning habitat and security cover for kittens. The Small Squeezer (1999) and Small Squeezer II (2000) timber harvests did not affect lynx habitat in the Lion Creek Subunit. Proposed salvage harvests in South Fork Lost Soup Subunit (Soup Creek Salvage 2002, 2003) would not alter existing denning habitat.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Canada Lynx***

  No additional activities would occur; therefore, no direct effects would be expected.

- ***Direct Effects Common to Action Alternatives B and C to Canada Lynx***

  Some disturbance of lynx could occur in areas with adequate cover for lynx to travel through. However, lynx appear to be relatively tolerant of human presence and road use (*Mowat 2000*); therefore, no substantial direct effects would be expected. A slight potential increase for mortality due to road traffic on gated and/or new roads would be possible, though the risk of this occurring would likely be extremely small. Lynx

TABLE F-4 - SUITABLE AND UNSUITABLE LYNX HABITAT ACRES ON DNRC LANDS WITHIN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SOUP GRIZZLY BEAR SUBUNITS

LYNX	SUBUNIT			
	GOAT CREEK	LION CREEK	SOUTH FORK LOST SOUP	GRAND TOTAL
Unsuitable habitat	5,372	2,850	6,173	14,395
Suitable habitat	633	232	12,154	13,019
Denning	33	0	1,113	1,146
Mature forage	202	7	5,185	5,394
Young forage	0	0	573	573
Nonhabitat	44	0	1,131	1,175
Other	354	225	4,152	4,731
Grand Total	6,005	3,082	18,327	27,414

do not appear to avoid roads at low traffic volumes (*Ruediger 2000*), so increased logging traffic on open and gated roads is not expected to displace or increase the energetic cost of individual lynx. The risks are higher under Action Alternative B, than Alternative C, but both alternatives are expected to result in very minor risks of negative direct effects.

Indirect Effects

- ***Indirect Effects Common to No-Action Alternative A and Action Alternative C to Canada Lynx***

  Under No-Action Alternative A and Action Alternative C, lynx would continue to use the project area similarly in the short-term because no lynx habitat would be modified under these alternatives. In the longer-term (barring natural disturbances), stands would continue to age and increase in the coarse woody debris needed for denning and security cover. Regenerating harvest units would mature and reduce habitat quality for snowshoe hares, potentially resulting in decreased primary prey availability for lynx. As these stands mature, habitat for red squirrels would increase, somewhat lessening the loss of prey. However, a diet of red squirrels might not provide the nutrients needed for the successful reproduction and rearing of kittens (*Koehler 1990*). Therefore, in the short term, no effects to lynx are expected. In the longer-term without disturbance, denning habitat is expected to increase, but foraging opportunities are expected to decrease, resulting in a reduced potential for lynx reproduction. However, these effects are believed to be minor because the affected habitat is marginal.

- ***Indirect Effects to Action Alternative B to Canada Lynx***

  Under this alternative, 31 acres of mature lynx foraging habitat would be modified in Unit 43. This unit would be harvested using a commercial thin silvicultural treatment, leaving 30 to 40 percent canopy cover following harvesting. This stand likely provides red squirrel habitat. Research indicates that red squirrel populations decline with removal of cone-producing trees (*Pearson 1999*). The proposed commercial thinning would result in decreased red squirrel foods (seeds), resulting in reduced squirrel population and lynx foraging opportunities to an unknown, but expected minimal degree. Additionally, since canopy closure following harvesting would likely be less than 40 percent, the 32 acres would be temporarily converted to *nonhabitat* for a period of 2 to 5 years until the retention tree canopies release and increase the canopy closure to more than 40 percent.

  The effects to lynx are expected to be minor and negative in the short-term (less than 5 years). These areas are lower in elevation and on warmer and drier sites than those typically used by lynx (*McKelvey 2000, Squires 2000*). Suitable habitat is limited in the project areas, so it is unlikely that enough habitat exists to support a pair of lynx. Therefore, any effects to this habitat would result in minor effects.

Cumulative Effects

- ***Cumulative Effects Common to No-Action Alternative A and Action Alternative C to Canada Lynx***

  Under these alternatives, no habitat would be modified. In time, denning habitat would

develop on much of the area at the expense of young forage. Snowshoe hare populations would remain relatively stable, but possibly at low densities due to the lack of the temporal high-density young successional habitats. Under these alternatives, barring any disturbance, forage availability would decrease, while denning habitat would increase. In some areas, primarily on industrial private lands higher in elevation, foraging habitat could increase as regeneration harvesting occurs. The effects to lynx would be negative and minor under this alternative due to the project affecting marginal habitat.

- ***Cumulative Effects of Action Alternative B to Canada Lynx***

  Under this alternative, 32 acres of lynx habitat in the Goat Creek Subunit would be converted to *unsuitable* for approximately 5 years. Habitat in the adjacent subunits would remain unchanged by this project. The conversion of habitat would be cumulative to other past harvesting on State and neighboring Plum Creek Timber Company lands. Since this alternative alters a small acreage in marginal habitat for a short period of time, the cumulative effects of this alternative would be minor and is highly unlikely to result in changes to lynx survival, reproduction, or use of the analysis area.

➢ GRAY WOLF

The gray wolf is listed as "endangered" under the Endangered Species Act. The *Northern Rocky Mountain Wolf Recovery Plan* defines 3 recovery zones (*USFWS 1987*). The proposed project is in the Northwest Montana Recovery Zone. The 3 recovery zones met the recovery standards for the last 2 years and are expected to meet the 10 packs per recovery area this year, initiating the delisting process.

The wolf is a wide-ranging, mobile species. Adequate habitat for wolves consists of adequate vulnerable prey and minimal human disturbance, especially at den and/or rendezvous sites. Primary prey species in northwest Montana are white-tailed deer, elk, moose, and mule deer. Distribution of wolves is strongly associated with white-tailed deer winter ranges. Wolves in northwest Montana typically den in late April. Wolves choose elevated areas in gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas for dens and rendezvous sites.

The project area contains elk and white-tailed and mule deer winter ranges, which could provide winter prey for wolves. Within the project area, the topography, access to water, and proximity to the big game winter range adhere to the description of denning and/or rendezvous-site habitats. Secure habitat away from roads is another important component of wolf habitat. Highway 83 and other open roads in the area occur in and near potential denning habitat. These roads increase mortality risk due to automobile collisions or illegal harvesting. Other roads in the project area are restricted to administrative use by a gate. Wolves could use the project area as part of their home range or be transient to the area; however, no recent denning or rendezvous sites have been documented and no recent use has been documented in or near the project area (*T. Meier, personal communication, USFWS, 9/18/02*).

For the cumulative-effects analysis, the overlap area between

1 mile around the project (including the project area) and a composite of elk and white-tailed and mule deer winter ranges was used (*FIGURE F-4 - WOLF AND BIG GAME CUMULATIVE EFFECTS ANALYSIS AREA*). The 1-mile buffer around each project-area parcel approximates the home range of an elk during winter and encompasses approximately the early spring season daily average movement (approximately 1 mile) of an adult wolf from the den or rendezvous site around each section (*Joslin 1966*). Therefore, the cumulative-effects area would include the majority of habitat a female wolf denning on big game winter range would use.

The cumulative-effects area consists of 24,748 acres. DNRC manages approximately 12,274 acres (49.6 percent), while USFS manages 2,831 acres (11.4 percent). Plum Creek Timber Company and small private owners control the remaining 9,634 acres (39.0 percent). The cumulative-effects area contains several open roads and Highway 83. Past harvest units on State trust and surrounding lands provide feeding opportunities for big game species. These units are generally gentle in topography and near water, thereby providing additional potential denning habitat. For more discussion on big game effects, refer to the *BIG GAME SPECIES* section in this analysis.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Wolves***

  Disturbance to wolves through harvesting activities or road use would remain at present levels. Under this alternative, disturbance to wolves resulting in decreased reproduction or mortality would not be likely.

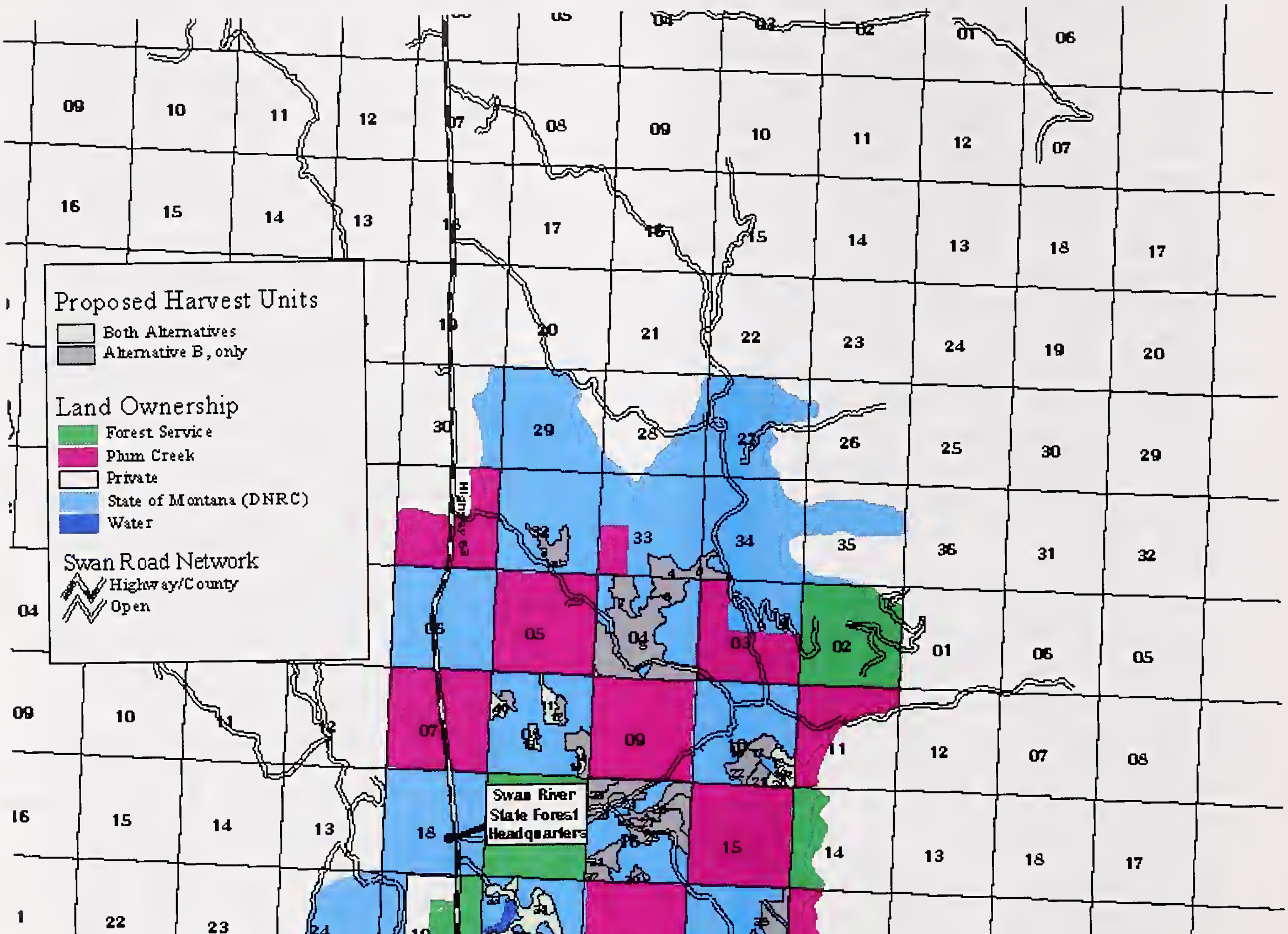
- ***Direct Effects of Action Alternative B to Wolves***

  Under Action Alternatives B, 10 segments of additional road, totaling 4.0 miles, would be built. Eight of these segments, totaling 2.6 miles of this new construction, would occur within the big game winter range. Two miles of these segments are extensions of existing roads, which would be obliterated or restricted following use. The remaining 0.6 miles would be built to relocate the Center Loop Road where it approaches Perry Creek (within 1/2 mile of Highway 83). This relocation would result in abandoning 0.3 miles of existing open road. In the event that wolves den in the area, an increase in road use would not likely result in appreciable disturbance to denning and rendezvous areas, because all the roads in the winter range would be built and used during the summer period (June 15 through August 15) or during the grizzly bear denning period (November 15 through April 1). These periods avoid the time of the year when wolves are highly susceptible to human disturbance and these roads would be restricted or obliterated following use. Therefore, no long-term disturbance effects are expected. If a wolf den or rendezvous site were found within 1 mile of any harvest unit, appropriate mitigation measures would be developed to minimize risk to wolves. The direct effects to the reproduction success of wolves under this alternative are expected to be negligible.

- ***Direct Effects of Action Alternative C to Wolves***

  Under Action Alternative C, 5 segments of additional road, totaling 1.8 miles, would be

FIGURE F-4 — WOLF AND BIG GAME CUMULATIVE EFFECTS ANALYSIS AREA



built within the winter range. Approximately 1.2 miles of these segments are extensions of existing roads, which would be obliterated or restricted following use. The remaining 0.6 miles would be built to relocate the Center Loop Road where it approaches Perry Creek (within 1/2 mile of Highway 83). This relocation would result in abandoning 0.3 miles of existing open road. In the event that wolves den in the area, the increase in road use would not likely result in appreciable disturbance to denning and rendezvous areas because all the roads in the winter range would be built and used during the summer period (June 15 through August 15) or during the grizzly bear denning period (November 15 through April 1). These periods avoid the time of the year when wolves are highly susceptible to human disturbance and these roads would be restricted or obliterated following use. Therefore, no long-term disturbance effects are expected. In the rare chance a wolf den or rendezvous site is found within 1 mile of any harvest unit, appropriate mitigation measures would be developed to minimize risk to wolves. The direct effects to the reproduction success of wolves under this alternative are expected to be negligible and less than Action Alternative B.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Wolves***

Under No-Action Alternative A, forest canopy closure would continue to develop thermal cover and decrease big game forage in the area. Since thermal cover appears limited in the project area, thermal cover increases would benefit wolves by maintaining or improving winter carrying capacity for white-tailed deer and elk. Under this alternative, if wolves use the area in the winter, the maintenance or increased amount of prey habitat and the available carrion in the Highway 83 corridor are expected to result in minor positive effects to wolves.

- ***Indirect Effects of Action Alternative B to Wolves***

Under this alternative, thermal cover would be reduced over 1,282 acres. This reduction is expected to result in decreased carrying capacity of winter habitat and potentially increase winter mortality of big game species, especially white-tailed deer. Initially, wolves could benefit from any increased carrion; however, the potential and extent that additional carrion may be available is uncertain and unknown. Prey is expected to decrease through time as populations decrease due to reduced thermal cover, resulting in increased winter mortality. However, the extent to which this would occur is unknown due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of preferred habitat, behavior adaptations, winter severity, and population levels. Wolves are not currently present in this portion of Swan Valley; however, should decreases in prey availability occur due to this alternative, the probability of wolf recolonization of this area could be reduced.

- ***Indirect Effects of Action Alternative C to Wolves***

Under this alternative, thermal cover would be reduced over 875 acres. This reduction is

expected to result decreased carrying capacity of winter habitat and potentially increase winter mortality of big game species, especially white-tailed deer. Initially, wolves could benefit from any increased carrion; however, the potential and extent that additional carrion may be available is uncertain and unknown. Prey is expected to decrease through time as populations decrease due to reduced thermal cover, resulting in increased winter mortality. However, the extent to which this would occur is unknown due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of preferred habitat, behavior adaptations, winter severity, and population levels. Wolves are not currently present in this portion of Swan Valley; however, should decreases in prey availability occur due to this alternative, the probability of wolf recolonization of this area could be reduced. The scale of the effects of this alternative would be less than under Action Alternative B.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Wolves***

  Under this alternative, thermal cover would be maintained at 5,706 acres (46 percent) on DNRC lands within the cumulative effects analysis area. The retention of existing thermal cover is expected to maintain the current carrying capacity of prey species. Harvesting of thermal cover on adjacent industrial and private lands are expected to continue. Conversely, no harvests are planned in the near future for 2,800 acres of USFS-managed lands. This alternative retains the highest amount of thermal cover in the analysis area and is not expected to reduce prey availability. However, the specific effects of these conditions are unknown due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of marginal habitat, behavior adaptations, winter severity, forest succession, and fluctuating population levels. Wolves are not currently present in this portion of Swan Valley, however; this alternative would retain existing prey availability, which is not expected to decrease the probability of wolf recolonization of this area.

- ***Cumulative Effects of Action Alternative B to Wolves***

  Under this alternative, 4,424 acres (36 percent) of thermal cover on DNRC lands would be present following harvesting. This alternative removes the highest amount of thermal cover. Continued harvesting of thermal cover on adjacent corporate and private lands is expected to continue, thereby further reducing big game carrying capacity. Conversely, no harvests are planned for USFS lands in the analysis area. This alternative would add to reductions of thermal cover in the analysis area, resulting in decreased prey availability. However, the extent to which prey availability would occur is unknown due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of marginal habitat, behavior adaptations, winter severity, and fluctuating population levels. Wolves are not currently present in this portion of Swan Valley; however, should decreases in prey

availability occur due to this alternative, wolf recolonization of this area would be reduced.

- ***Cumulative Effects of Action Alternative C to Wolves***

  Under this alternative, lower amounts of thermal cover would be removed from DNRC lands than under Action Alternative B. Following implementation of this alternative, 4,831 acres (39 percent) of thermal cover would be available for use by prey species. Continued harvesting of thermal cover on adjacent corporate and private lands is expected to continue, thereby further reducing big game carrying capacity. Conversely, no harvests are planned for USFS lands in the analysis area. This alternative would add to reductions of thermal cover in the analysis area, resulting in decreased prey availability. However, the extent to which prey availability would occur is unknown due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of marginal habitat, behavior adaptations, winter severity, and fluctuating population levels. Wolves are not currently present in this portion of Swan Valley; however, should decreases in prey availability occur due to this alternative, wolf recolonization of this area would be reduced, but less than under Action Alternative B.

➢ Grizzly Bear

Grizzly bears are listed as "threatened" under the Endangered Species Act. The Grizzly Bear Recovery Plan defines 6 recovery areas (*USFWS 1993*). This project is proposed in grizzly bear habitat in the North Continental Divide Ecosystem Recovery Area. The North Continental Divide Ecosystem is divided in to subunits. Each subunit approximates the size of a home range for a female bear and is separated from other subunits based on landscape features. This project is proposed in the Goat Creek, Lion Creek, and South Fork Lost Soup subunits.

Commitments made in the SVGBCA apply to this project. The Goat Creek subunit is open for harvesting during the nondenning period in the years 2003 through 2005 under the agreements made in the SVGBCA. The SVGBCA directs land managers to maintain more than 40 percent hiding cover, with no point of an opening further than 600 feet from cover; provide at least a 100-foot visual screening buffer along open roads adjacent to regeneration units (acceptable exceptions to this might occur along cable-logging units); and maintain less than 33 percent of each subunit in open-road densities above 1 mile per square mile. No total road-density standards for DNRC were outlined in the SVGBCA. Adherence to the guidelines documented in the SVGBCA is expected to reduce the risk of incidental take of grizzly bears.

The project area provides year-round habitat for grizzly bears. During the spring, bears search for winter-killed big game and lush green vegetation. During the summer, bears seek lush green vegetation typically found in riparian areas. In the late summer and into the autumn, bears switch primarily to a berry diet. The project area varies from low elevation in big game winter range with meadows and cutting units that provide vegetative food sources to subalpine areas. Big game carcasses are, at least, available in the spring. The project area also may provide birthing habitat for big game, which provides a source of prey

for bears in late spring. The mid and upper elevations provide summer and autumn habitat. This project could affect grizzly bears directly through increased road traffic, noise, and human activity indicated by changes in road densities, and indirectly by altering the amount and location of hiding cover and forage resources.

On State trust lands in the project area, 3,644 (61 percent) acres of the Goat Creek Subunit, 2,074 (68 percent) acres of the Lion Creek Subunit, and 14,845 (81 percent) acres of the South Fork Lost Soup Subunit provide hiding cover. The need for hiding cover increases as motorized access and human disturbance increase. Potential for human disturbance in the project area away from open roads is low and most of the roads that access the project area are restricted and used for administrative use only.

The cumulative-effects analysis was conducted using the Goat Creek, Lion Creek, and South Fork Lost Soup subunits. These subunits are primarily managed by DNRC, USFS, and Plum Creek Timber Company. (*TABLE F-5 - LAND OWNERSHIP (ACRES) IN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SOUP SUBUNITS*).

For the 2001 SVGBC Monitoring Report, DNRC, USFS, and Plum Creek Timber Company reported the current percent of hiding cover on their lands within each subunit (*TABLE F-6 - RESULTS OF COVER ANALYSES [ACRES] ON PCTC, STATE TRUST, AND USFS LANDS WITHIN THE SWAN CONSERVATION AGREEMENT AREA FOR 2000 [SWAN VALLEY CONSERVATION AGREEMENT MONITORING REPORT 2000]*). Hiding cover is believed to become limiting when it drops below 40 percent of the subunit. Presently, all subunits greatly exceed this criterion.

Access management is a major factor in managing grizzly bear habitat. Five open roads access the project area. These roads primarily run along creek courses. Many other restricted roads splinter off these open roads. A moving-windows analysis (*Ake 1994*) with the recent road data indicates that all these subunits are in compliance with the 33 percent open-road density standard (*Swan Valley Conservation*

TABLE F-5 - LAND OWNERSHIP (ACRES) IN THE GOAT CREEK, LION CREEK, AND SOUTH FORK LOST SOUP SUBUNITS

LAND OWNERSHIP	SUBUNIT NAME		
	GOAT CREEK	LION CREEK	SOUTH FORK LOST SOUP
USFS	14,210	18,420	11,010
Plum Creek	7,355	6,685	139
Private	0	780	408
State trust	6,006	3,050	18,327
Water	31	93	0
Grand total	27,602	29,028	29,884

TABLE F-6 - RESULTS OF COVER ANALYSES (ACRES) ON PLUM CREEK TIMBER COMPANY, STATE TRUST, AND USFS LANDS WITHIN THE SWAN CONSERVATION AGREEMENT AREA FOR 2000 (SWAN VALLEY CONSERVATION AGREEMENT MONITORING REPORT 2000)

LAND OWNERSHIP	SUBUNIT NAME		
	GOAT CREEK (PERCENT)	LION CREEK (PERCENT)	SOUTH FORK LOST SOUP (PERCENT)
USFS	9,521 (67)	12,894 (70)	8,258 (75)
Plum Creek	6,325 (86)	4,880 (73)	122 (88)
State trust	3,664 (61)	2,074 (68)	14,845 (81)
Grand totals	19,510 (71)	19,848 (68)	23,225 (79)

Agreement Monitoring Report 2002). Managing motorized access reduces the potential for mortality, displacement from important habitats, and habituation to humans, and provides relatively secure habitat to reduce the energetic requirements (*IGBC 1998*).

Direct Effects

- ***Direct Effects of No-Action Alternative A Grizzly Bears***

  No additional direct effects would occur under this alternative.

- ***Direct Effects Common to Action B and C to Grizzly Bears***

  Under this alternative, harvest units contained in the Goat Creek Subunit, but outside the linkage zone, could be harvested during any period of the year between 2003 and 2005. Any units in the Goat Creek Subunit and in the linkage zone would be harvested between June 15 and August 31. All other units would be harvested during the denning period (November 16 through March 31). Under these conditions, any additional disturbances to grizzly bears would be minor

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Grizzly Bears***

  Under this alternative, no additional habitat would be altered. Hiding cover would be retained at 74.5 percent on DNRC lands in the project area. In time, hiding cover would continue to develop at the expense of forage. No additional disturbance due to road use would occur. Therefore, negligible effects are expected.

- ***Indirect Effects Common to Action Alternatives B and C to Grizzly Bears***

  Under Action Alternatives B and C, timber harvesting would reduce hiding cover. To assess the reduction in hiding cover, hiding cover is assumed to be removed in all harvest units where harvests reduce overstory cover to 50 percent or less. Timber harvesting would reduce hiding cover in the project area by 1,208 acres under Action Alternative B and 1,157 acres under Action Alternative C (*TABLE F-7 - GRIZZLY BEAR HIDING COVER ON TRUST LANDS AFFECTED BY ACTION ALTERNATIVE B* and *TABLE F-8 - GRIZZLY BEAR HIDING COVER ON TRUST LANDS AFFECTED BY ACTION ALTERNATIVE C*). Hiding cover is especially important along roads and in areas of human disturbance; therefore, visual screening would be retained along all open roads in the project area where regeneration harvests occur adjacent to the road and no point within any even-aged harvest unit would be over 600 feet to cover. Hiding cover in these harvested units is expected to regenerate in 20 to 30 years. Since hiding cover is

TABLE F-7 — GRIZZLY BEAR HIDING COVER ON TRUST LANDS AFFECTED BY ACTION ALTERNATIVE B

SUBUNIT	HIDING COVER			
	ACRES EXISTING	ACRES REMOVED	ACRES REMAINING	PERCENT REMAINING
Goat Creek	3,664	1,025	2,639	43.9
Lion Creek	2,074	181	1,893	62.1
South Fork Lost Soup	14,845	2	14,843	81.0
Totals	20,583	1,208	19,375	70.8

TABLE F-8 - GRIZZLY BEAR HIDING COVER ON TRUST LANDS AFFECTED BY ACTION ALTERANTIVE C

SUBUNIT	HIDING COVER			
	ACRES EXISTING	ACRES REMOVED	ACRES REMAINING	PERCENT REMAINING
Goat Creek	3,664	974	2,670	44.5
Lion Creek	2,074	181	1,893	62.1
South Fork Lost Soup	14,845	2	14,843	81.0
Totals	20,583	1,157	19,462	70.9

not limiting in the area, these losses are expected to result in negligible effects to grizzly bears. However, Action Alternative B reduces hiding cover closer to 40 percent on DNRC-managed lands in the Goat Creek Subunit.

Following treatment, reducing canopy cover and burning could stimulate berry-producing plants and other forage (*Marten 1979, Zager 1980*). However, mechanical scarification or a hot fire may reduce the response of berry-producing plants (*Zager 1980*). In areas with large patches of berry-producing plants, attempts would be made to avoid these patches or minimize damage to vegetative organs when mechanically scarifying the area. Increased forage would be approximately proportional to canopy removal. Therefore, forage increases are expected to be higher in Action Alternative B then under Action Alternative C. The effects of both action alternatives would be positive and minor.

To accomplish harvests, 29.9 and 13.7 miles of restricted roads would be used during the non–denning period under Action Alternatives B and C, respectively. These roads would be used for commercial purposes and would not allow public use over a period of several years. Disturbance associated with these roads are expected to result in decreased use of adjacent habitats by grizzly bears. This is expected to result in minor negative effects to grizzly bears due to relatively undisturbed habitat in other subunits. Action Alternative B is expected to result in more negative effects than Action Alternative C.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Grizzly Bears***

Under No-Action Alternative A, motorized access to the area would remain unchanged. In the short-term, hiding cover would be retained at the highest amount of any alternative (*TABLE F-9 – ACRES [PERCENT] HIDING COVER RETAINED UNDER EACH ALTERNATIVE BY SUBUNIT*). Forest succession would continue and could reduce food sources for grizzly bears, but increase the amount of hiding cover. Since hiding cover does not appear limiting in the subunit, maintaining this cover at the expense of food resources could reduce grizzly bear forage-habitat quality in the subunit through time, resulting in negative minor effects.

- ***Cumulative Effects of Action Alternatives B and C to Grizzly Bears***

Under Action Alternatives B and C, timber harvesting would not reduce hiding cover below 40 percent in any subunit (*TABLE F-9 – ACRES [PERCENT] HIDING COVER RETAINED UNDER EACH ALTERNATIVE BY SUBUNIT*). Since all subunit

TABLE F-9 — ACRES (PERCENT) OF HIDING COVER RETAINED UNDER EACH ALTERNATIVE BY SUBUNIT

ALTERNATIVES	SUBUNIT NAME		
	GOAT CREEK (PERCENT)	LION CREEK (PERCENT)	SOUTH FORK LOST SOUP (PERCENT)
No-Action Alternative A	19,510 (70.7)	20,383 (72.2)	23,215 (78.8)
Action Alternative B	18,485 (67.0)	20,202 (69.6)	23,213 (77.7)
Action Alternative C	18,536 (67.2)	20,202 (69.6)	23,213 (77.7)

estimates are well above 40 percent, no measurable effects to grizzly bears are expected.

Impacts to grizzly bears could intensify when the open-road density exceeds 1 mile per square mile because at this road density bears tend to avoid otherwise suitable habitat (*Mace et al. 1997*). Under both action alternatives, road use for commercial and administrative purposes would temporarily increase during the nondenning period in the Goat Creek Subunit as allowed under the SVGBCA. In the Lion Creek and South Fork Lost Creek Subunits, harvesting activities would occur during the denning period, resulting in no effects to grizzly bears. The increases in disturbance associated with timber harvesting and roads in the Goat Creek Subunit would be higher under Action Alternative B than Action Alternative C. During the project, avoidance of some habitats could occur in the cumulative effects area. Harvesting activities on Plum Creek Timber Company lands in the Goat Creek Subunit increases these effects. Under the SVGBCA, other adjacent subunits (South Fork Lost, Lion Creek, and Porcupine Woodward) are closed to commercial uses during the nondenning season, thereby providing areas of low disturbance to bears for dispersion. Therefore, the effects of both action alternatives are expected to be minor.

SENSITIVE SPECIES

When conducting forest-management activities, the SFLMP directs DNRC to give special consideration to the several "sensitive" species. These species are sensitive to human activities, have special habitat requirements that may be altered by timber management, or may become listed under the Federal Endangered Species Act if management activities result in continued adverse impacts. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE F-10 - LISTED SENSITIVE SPECIES FOR THE NORTHWEST LAND OFFICE SHOWING THE STATUS OF THESE SENSITIVE SPECIES IN RELATION TO THIS PROJECT*, each sensitive species was either included in the following analysis or was dropped from further analysis for various reasons.

➢ Fisher

Due to their use of mature and late-successional forested habitats, fishers are listed by DNRC as a sensitive species (*DNRC 1996*). DNRC's strategy to

TABLE F-10 - LISTED SENSITIVE SPECIES FOR THE NORTHWESTERN LAND OFFICE OF DNRC

SPECIES	DETERMINATION - BASIS
Black-backed woodpecker	No further analysis conducted - no recently (less than 5 years) burned areas in the project area would be affected.
Boreal owl	No further analysis conducted - all harvest areas occur below 5,000 feet in elevation.
Coeur d'Alene salamander	No further analysis conducted - no moist talus or streamside talus habitat occurs in the project area.
Columbian sharp-tailed grouse	No further analysis conducted - no suitable grassland communities occur in the project area.
Common loon	No further analysis conducted - no breeding pairs have been documented in the project area.
Ferruginous hawk	No further analysis conducted - no suitable grassland communities occur in the project area.
Fisher	*Included* - potential fisher habitat occurs along drainages in the project area.
Flammulated owl	*Included* -ponderosa pine habitats occur in the project area.
Harlequin duck	No further analysis conducted - no harvesting would occur in potential habitat along perennial streams.
Mountain plover	No further analysis conducted - no suitable grassland communities occur in the project area.
Northern bog lemming	No further analysis conducted - no sphagnum or other fen/moss mats occur in the area.
Pileated woodpecker	*Included* - western larch/Douglas fir and mixed-conifer habitats occur in the area.
Townsend's big-eared bat	No further analysis conducted - no caves or mine tunnels occur in the project area.

conserve fishers in a managed landscape is aimed at protecting valuable resting habitat near riparian areas and maintaining travel corridors.

Fishers are generalist predators and use a variety of habitat types, but are disproportionately found in stands with dense canopy (*Powell 1982, Johnson 1984*). Fishers appear to be highly selective of resting and denning sites. In the Rocky Mountains, fishers appear to prefer late-successional coniferous forests for resting sites and use riparian areas disproportionately to their availability. Fishers tend to use areas within 155 feet of water. Such areas contain large live trees, snags, and logs, which are used for resting and denning sites and dense canopy cover, which is important for snow intercept (*Jones 1991*). Timber harvesting and associated road construction could affect fishers by altering habitat and/or by increasing susceptibility to trapping.

On State trust lands in the project area, SLI data were analyzed (by covertype and age class) to assess potential fisher habitat using criteria outlined in *Heinemeyer and Jones (1994)*. In the project area, an estimated 655 acres (7.1 percent) provide resting/denning habitat, 5,819 acres (63.3 percent) provide foraging habitat, and 284 acres (3.1 percent) provide travel habitat. Additionally, travel corridors connect the parcels of State trust lands. Recent regeneration harvests on Plum

Creek lands create a barrier to fisher movement; however, adjacent lands appear to provide adequate travel corridors to bypass unsuitable units.

Trapping pressure was responsible for the extirpation of fisher over most of their range by the 1930s. Although they again inhabit this area, populations remain vulnerable to trapping because fishers are easily caught in traps set for martens, bobcats, and coyotes. However, fishers are rare and are not trapped often. Vulnerability to trapping is influenced by the miles of road, both open and closed.

The Goat Creek, Lion Creek, and South Fork Lost Soup Grizzly Bear Subunits were used to assess cumulative effects. For a description of the subunit and ownership, please refer to *Grizzly Bear* in this analysis. In the cumulative effects analysis area, State trust lands provide potential denning/resting, foraging, and travel habitat (*TABLE F-11 - FISHER HABITAT FOUND IN THE PROJECT AREA AND IN THE DNRC-MANAGED LANDS WITHIN THE SUBUNIT*). Recent regeneration harvests on Plum Creek Timber Company lands could create a barrier to fisher movement; however, adjacent lands appear to provide adequate travel corridors to bypass unsuitable units. Continued salvage harvesting on DNRC and Plum Creek Timber Company land would continue to decrease the quality of fisher denning/resting habitat, while regeneration harvesting would remove habitat and decrease habitat quality in adjacent stands for some time (20 to 30 years). When stands regenerate enough to provide snowshoe hare habitat, fishers could use these stands for forage and travel.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Fishers***

  Under No-Action Alternative A, no additional human disturbance or increased vulnerability to trapping would occur.

- ***Direct Effects of Action Alternative B to Fishers***

  Under Action Alternative B, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative B (2,440 acres) poses more risk than does Action Alternative C (1865 acres).

  Under Action Alternative B, 3.4 miles of new road would be constructed. These new roads are short extensions of existing roads and would be either obliterated or restricted following use. In the short-

TABLE F-11 - FISHER HABITAT FOUND IN THE PROJECT AREA AND ON DNRC-MANAGED LANDS WITHIN IN THE SUBUNIT

SUBUNIT NAME		DNRC OWNERSHIP (ACRES)	DENNING/ RESTING (ACRES)	FORAGE (ACRES)	TRAVEL (ACRES)
Goat Creek	Project area	4,529	315	2,804	165
	Subunit	6,006	740	3,647	232
Lion Creek	Project area	3,012	107	2,027	16
	Subunit	3,082	149	2,285	16
South Fork Lost Soup	Project area	1,652	233	988	103
	Subunit	18,327	5,693	10,821	289

term, increased vulnerability could occur, but the increased vulnerability would be minor. These roads do not substantially increase human access or trapping; therefore, no increase in fisher mortality due to increased access is expected.

- ***Direct Effects of Action Alternative C to Fishers***

  Under Action Alternative C, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative C poses less risk than does Action Alternative B.

  Under this alternative, 1.2 miles of new road would be constructed. These new roads are short extensions of existing roads and would be either obliterated or restricted following use. In the short-term, increased vulnerability could occur, but the increased vulnerability would be minor. These roads do not substantially increase human access or trapping; therefore, no increase in fisher mortality due to increased access is expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fishers***

  Under No-Action Alternative A, fisher habitat would remain relatively unchanged in the short-term. In the longer-term, more resting/denning habitat would develop. Fishers would benefit from the increased habitat and no increase in mortality risk, resulting in a potential increase in fisher use in the area.

- ***Indirect Effects of Action Alternative B to Fishers***

  Under Action Alternative B, 262 acres of denning habitat and 1,715 acres of foraging habitat would be modified. In seedtree units (270 acres), harvesting would remove fisher habitat for a period of time (20 to 30 years) and reduce the habitat quality in the adjacent stands, because fishers avoid openings (*Roy 1991, Jones 1991*) and are rarely detected near abrupt-edge habitat adjacent to clearcuts (*Heinemeyer, unpublished*). The retention of seedtrees and snags would provide resting/denning structure for the future stand. Additionally, the regenerating units could provide foraging habitat (snowshoe hare habitat) in the future (20 to 30 years). A 165-foot, no-harvest buffer along perennial streams and an 83-foot, no-harvest buffer along intermittent streams would be retained to protect potential high quality resting habitat and travel corridors, since fishers travel along stream courses and prefer habitats in proximity of water (*Jones 1991, Heinemeyer 1993*). This proposed alternative would reduce fisher habitat in the proposed harvest units; however, habitat and travel corridors along perennial streams would be retained to provide fisher resting/denning habitat and allow movement through the project area with the exception of Section 4, where harvesting could result in developing a barrier to fisher movements for approximately 20 to 30 years. Within each unit, snags and large trees would be retained to provide denning/ resting sites in the future, reducing the amount of time needed to become fisher habitat from 100+ years to develop resting structure to 20 to 30 years needed to develop

horizontal cover. The reduction of denning/resting sites and foraging habitat in the uplands would result in increased energy expenditures, while decreasing forage opportunities. This alternative is expected to remove important fisher habitat, while retaining travel corridors along stream courses, resulting in minor negative effects to fishers.

- ***Indirect Effects of Action Alternative C to Fishers***

  Under Action Alternative C, 254 acres of denning habitat and 1,228 acres of forage habitat would be modified. In seedtree units (233 acres), the harvests would remove fisher habitat for a period of time (20 to 30 years) and reduce the habitat quality in the adjacent stands, because fishers avoid openings (*Roy 1991, Jones 1991*) and are rarely detected near abrupt-edge habitat adjacent to clearcuts (*Heinemeyer, unpublished*). The retention of seedtrees and snags would provide resting/denning structure for the future stand. Additionally, the regenerating units might provide foraging habitat (snowshoe hare habitat) in the future (20 to 30 years). A 165-foot, no-harvest buffer along perennial streams and an 83-foot, no-harvest buffer along intermittent streams would be retained to protect potential high quality resting habitat and travel corridors, since fishers travel along stream courses and prefer habitats in proximity of water (*Jones 1991, Heinemeyer 1993*). This proposed alternative would reduce fisher habitat in the proposed harvest units; however, habitat and travel corridors along perennial streams would be retained to provide fisher resting/denning habitat and allow movement through the project area with the exception of Section 4, where harvesting could result in developing a barrier to fisher movements for approximately 20 to 30 years. Within each unit, snags and large trees would be retained to provide denning/resting sites in the future, reducing the amount of time needed to become fisher habitat from 100+ years to develop resting structure to 20 to 30 years needed to develop horizontal cover. The reduction of denning/resting sites and foraging habitat in uplands would result in increased energy expenditures, while decreasing forage opportunities. This alternative is expected to remove important fisher habitat, while retaining travel corridors along stream courses, resulting in minor negative effects to fishers, but less than under Action Alternative B.

Cumulative Effects

Salvage operation on State trust lands decreased habitat. Salvage and regeneration harvests, especially in mature and late successional stands, reduced the amount of habitat available on State trust lands and adjacent industrial private lands. Habitat conditions on USFS lands are expected to improve in time; however, these lands occur higher in the drainage and are probably used less by fishers than the lower elevations. Under all alternatives, movement corridors from the project area into the cumulative effects area would be retained. The effects of the new roads discussed above would also apply to the cumulative effects area. Overall, Action Alternative B would combine with other activities on DNRC-managed and corporate private lands to produce minor negative effects to fishers. Less minor effects are expected under Action Alternative C.

➢ **FLAMMULATED OWL**

Flammulated owls are listed by DNRC as sensitive due to their use of old, open-grown ponderosa pine old-growth habitats. They usually nest in cavities in 12- to 25-inch dbh quaking aspen, ponderosa pine, or Douglas-fir that have been excavated by pileated woodpeckers or northern flickers.

To assess flammulated owl habitat, SLI data were used. Stands that met the following criteria were considered flammulated owl habitat: 1) appropriate covertype of ponderosa pine, and 2) stand age of more than 100 years. Based on these criteria, 1,525 acres of flammulated owl habitat occurs in the project area. Of these acres, 1,256 acres contain dense canopy cover (>70 percent canopy closure) which reduces flammulated owl habitat.

Since the project area is large, the analysis conducted for the project area encompassed a large enough area to support several pairs of flammulated owls. Therefore, the cumulative effects analysis area is the project area and adjacent parcels.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Flammulated Owls***

  No additional disturbance would occur in the project area.

- ***Direct Effects Common to Action Alternatives B and C to Flammulated Owls***

  Flammulated owls appear to tolerate human disturbance and rarely abandon a nest. If harvesting occurs during nesting and rearing periods (May-July), a nest tree could be inadvertently cut down. This risk would be low because most nest trees posses some rot, therefore, they have low merchantability and would likely not be harvested. Harvests would avoid the nesting and rearing season outside of the Goat Creek Grizzly Bear Subunit. Otherwise, these alternatives are not expected to directly affect flammulated owls.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Flammulated Owls***

  Flammulated owl habitat would be maintained in poor condition and would continue to decline.

- ***Indirect Effects of Action Alternative B to Flammulated Owls***

  Under Action Alternative B, timber harvesting would open the canopy of the forested areas and favor ponderosa pine on 671 acres. The retained dominant trees would be expected to increase growth rates due to reduced competition. Additionally, all western larch and ponderosa pine snags larger than 21 inches dbh and further than 200 feet from an open road would be retained. Some losses of these snags could occur during harvesting; however, these trees/snags would be retained on site. Harvesting would not reduce the number of live western larch and ponderosa pine larger than 21 inches to less than 8 trees per acre and would potentially increase vigor and growth rates of the retention trees, while decreasing the susceptibility of these trees to wildfire. This action would benefit flammulated owl by enhancing habitat quality and quantity.

- ***Indirect Effects of Action Alternative C to Flammulated Owls***

  Under Action Alternative C, timber harvesting would open the canopy of the forested areas and favor ponderosa pine on 108 acres. The retained dominant trees would be expected to

increase growth rates due to reduced competition. Additionally, all western larch and ponderosa pine snags larger than 21 inches dbh and farther than 200 feet from an open road would be retained. Some losses of these snags could occur during harvesting; however, these trees/snags would be retained on site. Harvesting would not reduce the number of live western larch and ponderosa pine larger than 21 inches to less than 8 trees per acre and would potentially increase vigor and growth rates of the retention trees, while decreasing their susceptibility to wildfire. This action would benefit flammulated owls by enhancing habitat quality and quantity, but less than under Action Alternative B.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Flammulated Owls***

  Under No-Action Alternative A, flammulated owl habitat would continue to decline throughout the area, resulting in minor adverse effects to flammulated owls.

- ***Cumulative Effects of Action Alternatives B and C to Flammulated Owls***

  Under Action Alternatives B and C, 681 and 108 acres of habitat, respectively, would be enhanced, resulting in minor positive effects to owls. The increase in habitat is expected to produce benefits to flammulated owls. These pockets of habitats could provide dispersal areas and new breeding territories. The increases would add flammulated owl habitat in the area and would be additive to the unknown quantity and quality of habitat on adjacent lands. Continued harvests on industrial private lands that remove large trees, especially ponderosa pine, is expected to reduce flammulated owl habitat in the area.

➢ Pileated Woodpecker

Pileated woodpecker are listed by DNRC as sensitive and play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals.

Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as "stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*).

Potential pileated woodpecker nesting habitat was identified by searching the SLI database for *old stands* with more than 100 square feet basal area per acre, more than 40 percent canopy cover, and below 5,000 feet in elevation. Based on these parameters, approximately 2,805 acres (43.9 percent) of potential nesting habitat for pileated woodpeckers exist on DNRC lands scattered throughout the project area. Younger aged stands could provide feeding or lower quality nesting habitat. Since the project area

is large, the analysis conducted for the project area encompassed enough area to support several pairs of pileated woodpeckers. Therefore, the cumulative effects analysis area is the project area and adjacent parcels.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur.

- ***Direct Effects Common to Action Alternatives B and C to Pileated Woodpeckers***

  Under the action alternatives, pileated woodpeckers could be affected if harvesting occurred during the nesting period. Nesting woodpeckers could be displaced by the harvesting activities. The effects of harvesting disturbance is unknown; however, *Bull et al. (1995)* observed a discernible woodpecker roosting near a harvest unit consistently throughout harvesting. Additionally, mortality of individual woodpeckers could occur if nest trees were inadvertently cut. This risk would be low because most nest trees possess some rot; therefore, they have low merchantability and would likely not be harvested. Action Alternative B would result in a low risk of directly affecting pileated woodpeckers. Action Alternative C would result in slightly less risk of directly affecting pileated woodpeckers than Action Alternative B.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  The existing trees would continue to grow and die, thus providing potential nesting and foraging substrate for pileated woodpeckers. However, as these trees die, barring any disturbance, replacement trees (shade-intolerant) would not be present. Therefore, under this alternative, pileated woodpecker habitat would increase through time, then decline, resulting in a short- to mid-term moderate beneficial effect to pileated woodpeckers, but a long-term minor negative effect.

- ***Indirect Effects of Action Alternative B to Pileated Woodpeckers***

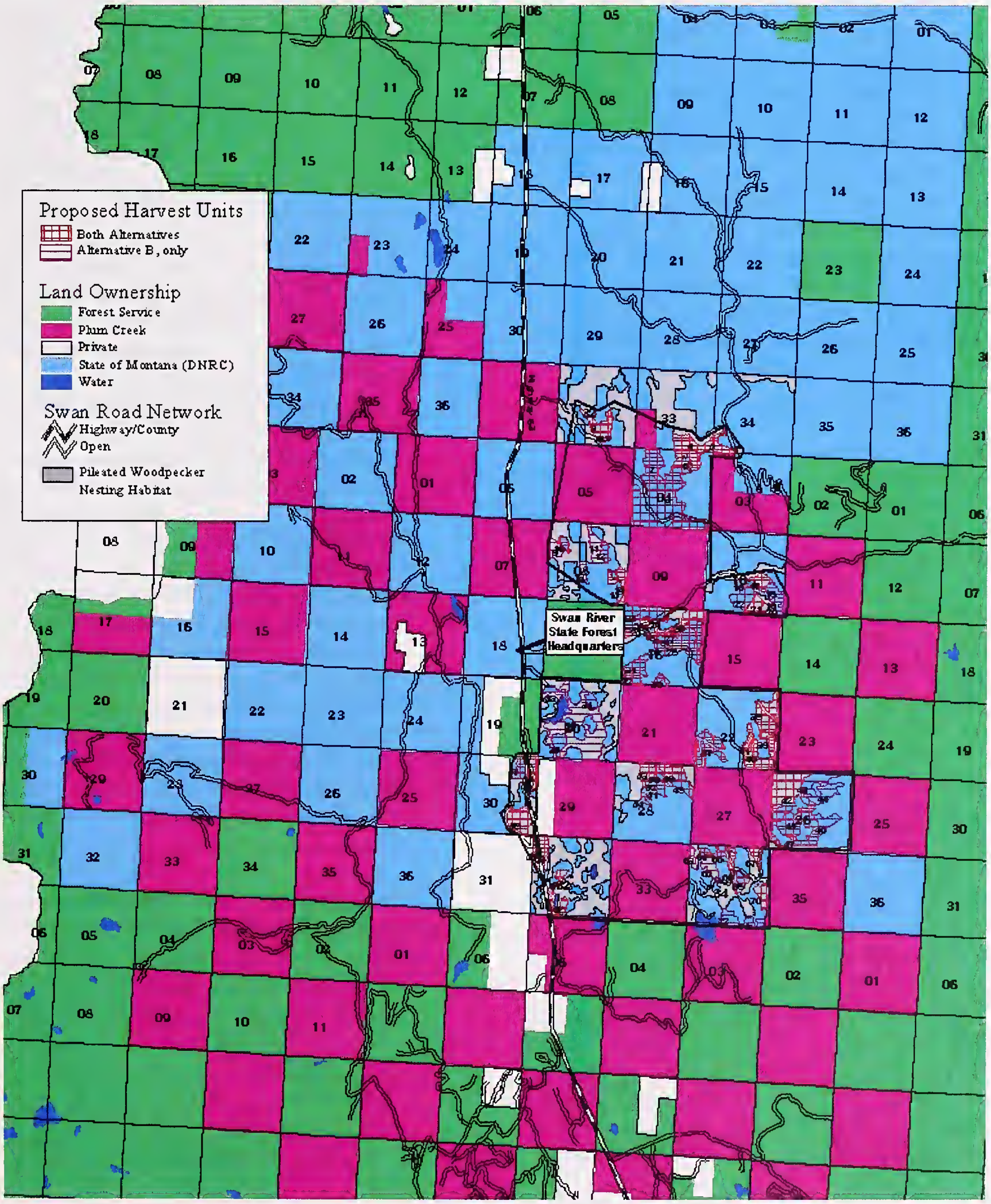
  Under Action Alternatives B, 996 acres of pileated woodpecker nesting habitat in the project would be modified, leaving at least 1,809 acres of nesting habitat unaltered (*TABLE F—12—SUMMARY OF PILIEATED WOODPECKER HABITAT MODIFIED BY EACH ALTERNATIVE*). The seedtree harvests (112 acres) would reduce the quality of nesting habitat for a long period of time in all proposed units. Other treatments that remove midstory canopy could reduce the quality of nesting habitat (*McClelland 1979*). In the other proposed units (884 acres), treatments would leave most of the dominant trees and 25 to 75

TABLE F-12 - SUMMARY OF PILEATED WOODPECKER HABITAT MODIFIED BY EACH ALTERNATIVE

ALTERNATIVE	POTENTIAL NESTING HABITAT MODIFIED (ACRES)	POTENTIAL NESTING HABITAT REMOVED (ACRES)	POTENTIAL NESTING HABITAT NEGATIVELY MODIFIED (ACRES)	POTENTIAL NESTING HABITAT MODIFIED BUT AVAILABLE (ACRES)
A	0	0	0	0
B	996	112	511	373
C	713	96	360	257

percent canopy cover (*FIGURE F-5 - PILEATED WOODPECKER HABITAT IN THE PROJECT AREA AND STANDS PROPOSED FOR HARVESTING UNDER THE GOAT SQUEEZER TIMBER SALE PROJECT*). Many of the dominant trees would be retained and would be expected to increase growth rates due to reduced competition. Additionally, all western larch and ponderosa pine snags greater than 21 inches dbh and further than 200 feet from an open road would be retained. However, some snags could be lost due to harvesting. These snags would be left on site to provide feeding substrates for

FIGURE F-5 - PILEATED WOODPECKER HABITAT IN THE PROJECT AREA AND STANDS PROPOSED FOR HARVESTING UNDER THE GOAT SQUEEZER PROJECT



pileated woodpeckers and other wildlife species. trees larger than 21 inches and larger than 17 inches dbh occur in all of the proposed harvest units. Harvesting would not reduce the number of live western larch and ponderosa pine larger than 21 inches dbh to less than 8 trees per acre and would potentially increase the vigor and growth rate of all the retention trees, while decreasing the susceptibility of these trees to wildfire. Since pileated woodpeckers use areas that average between 41 and 51 percent canopy cover for nesting and roosting (*McClelland and McCelland 1999*) and dominant trees and snags would be retained, the effects of these treatments on pileated woodpeckers would be minimal in stands meeting these criteria following harvest (373 acres). Similarly, *Bull et al. (1995)* found that pileated woodpeckers still used stands following harvesting if habitat qualities are retained. If nesting habitat was removed, the retention criteria would retain feeding sites (if available prior to harvesting) in all harvest units. Some reductions in feeding habitat could occur due to the harvesting of large Douglas-fir and, potentially, other large trees of other species. This removal would likely result in decreased pileated woodpeckers reproduction in the area until these units regenerate to provide adequate canopy and midstory cover. This alternative is expected to result in moderate negative effects to pileated woodpeckers in the short- to mid-term, while regeneration of shade-intolerant tree species could provide minor beneficial effects in the distant future.

- ***Indirect Effects of Action Alternative C to Pileated Woodpeckers***

Under Action Alternative C, 713 acres of pileated woodpecker nesting habitat would be modified, leaving at least 2,092 acres of nesting habitat unaltered. The seedtree-type harvests (96 acres) would reduce nesting-habitat quality for a long period of time in those proposed units. Other treatments that remove midstory canopy could reduce nesting cover quality (McClelland 1979). In the remaining proposed units (617 acres), treatments would leave most of the dominant trees and 25 to 75 percent canopy cover (*FIGURE F-5 - PILEATED WOODPECKER HABITAT IN THE PROJECT AREA AND STANDS PROPOSED FOR HARVESTING UNDER THE GOAT SQUEEZER TIMBER SALE PROJECT*). Many of the dominant trees would be retained and are expected to increase growth rates due to reduced competition. Additionally, all western larch and ponderosa pine snags larger than 21 inches dbh and further than 200 feet from an open road would be planned for retention. Some losses of these snags could occur during harvesting; however, these trees/snags would be left on site to provide feeding substrate for pileated woodpeckers. In all the proposed harvest units, trees larger than 21 inches and larger than 17 inches dbh occur. Harvesting would not reduce the number of live western larch and ponderosa pine larger than 21 inches dbh to less than 8 trees per acre and would, potentially, increase the vigor and growth rate of the retained trees, while decreasing the susceptibility of these trees to wildfire. These snags would be left on sight to provide feeding sites for pileated woodpeckers and other wildlife species.

Since pileated woodpeckers use areas that average 41 and 51 percent canopy cover for nesting and roosting (*McClelland and McCelland 1999*) and dominant trees and snags would be retained, the effects of these treatments on pileated woodpeckers would be minimal in stands meeting these criteria postharvest (257 acres). Similarly, *Bull et al. (1995)* found pileated woodpeckers still used stands following harvesting if habitat qualities were retained. If nesting habitat was removed, the retention criteria would retain feeding sites (if available prior to harvesting) in all harvest units. Some reductions in feeding habitat could occur due to the harvesting of large Douglas-fir and, potentially, other large trees of other species. This removal would likely result in decreased pileated woodpeckers reproduction in the area until these units regenerate to provide adequate canopy and midstory cover. Action Alternative C is expected to result in moderate risk of negative effects to pileated woodpeckers in the short- to mid-term, while regeneration of shade-intolerant tree species could provide minor beneficial effects in the distant future. These effects are expected to be less than those experienced under Action Alternative B.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

  Pileated woodpecker habitat in and around the project area would increase through time on DNRC lands, then decline. This No-Action Alternative A would result in continued retention of the existing 2,805 acres of pileated woodpecker habitat on DNRC lands. However, pileated woodpecker nesting habitat on adjacent corporate lands is expected to decline due to timber harvesting. On USFS lands, pileated habitat is expected to be retained. These conditions would result in an overall decrease in nesting habitat for pileated woodpeckers in the area.

- ***Cumulative Effects Common to Action Alternatives B and C to Pileated Woodpeckers***

  Under Action Alternatives B and C, potential nesting cover would be reduced; this loss would be additive to past harvesting, current harvesting on Plum Creek Timber Company land, and salvage operations on DNRC lands. Under Action Alternative B, pileated woodpecker habitat in the analysis area would be reduced (996 acres) more than under Action Alternative C (713 acres). The reduction is expected to cumulatively contribute to reduced habitat quality and quantity in the analysis area. This could result in moderate decreases in the number of pairs that could inhabit the analysis area. Long-term minor benefit could be realized by the regeneration of shade-intolerant trees species that are important nesting substrates.

BIG GAME SPECIES

DFWP delineated major winter ranges for big game species in the State. The project area lies in white-tailed deer, elk, and mule deer winter ranges. White-tailed deer, elk, mule deer, and moose use the area in the nonwinter period. Typically, moose winter in other areas further away. The big game analysis focuses on winter range; therefore, white-tailed deer, elk, and mule deer will be discussed, while moose will not be further

considered in this analysis. The project area contains approximately 2,779 acres (43 percent) stands providing thermal cover within the defined winter range delineated by DFWP. Meadows and old cutting units provide forage.

For cumulative effects, an area approximating the winter home range of an elk herd was used. This area was defined by buffering each section by 1 mile. The cumulative effects area consists of 24,748 acres. DNRC manages approximately, 12,274 acres (49.6 percent), while USFS manages 2,831 acres (11.4 percent). Plum Creek Timber Company and small private landowners control the remaining 9,634 acres (39.0 percent). The cumulative-effects area contains several open roads and Highway 83. Past harvest units on State trust and surrounding lands provide feeding opportunities for big game species. The area experienced numerous timber harvests over the past 2 decades, removing large amounts of thermal cover (*FIGURE F-6 - BIG GAME SPECIES CUMULATIVE-EFFECTS ANALYSIS AREA AND THERMAL COVER PROVIDED ON DNRC-MANAGED LANDS IN THE ANALYSIS AREA*).

Direct Effects

- ***Direct Effects of No Action Alternative A to Big Game Species***

  Human use in the area is not expected to increase. Therefore, no additional direct effects are expected.

- ***Direct Effects of Action Alternatives B and C to Big Game Species***

  Under Action Alternatives B and C, human use in the area may disturb wintering big game. Winter logging operations would maintain roads in A drivable condition for commercial operations. These roads would also be available for public access. Increased public use of the area could increase disturbance of wintering big game animals. To mitigate for these impacts, the restricted roads would be closed to public use by a gate when logging operations are not occurring (weekends, evenings, holidays).

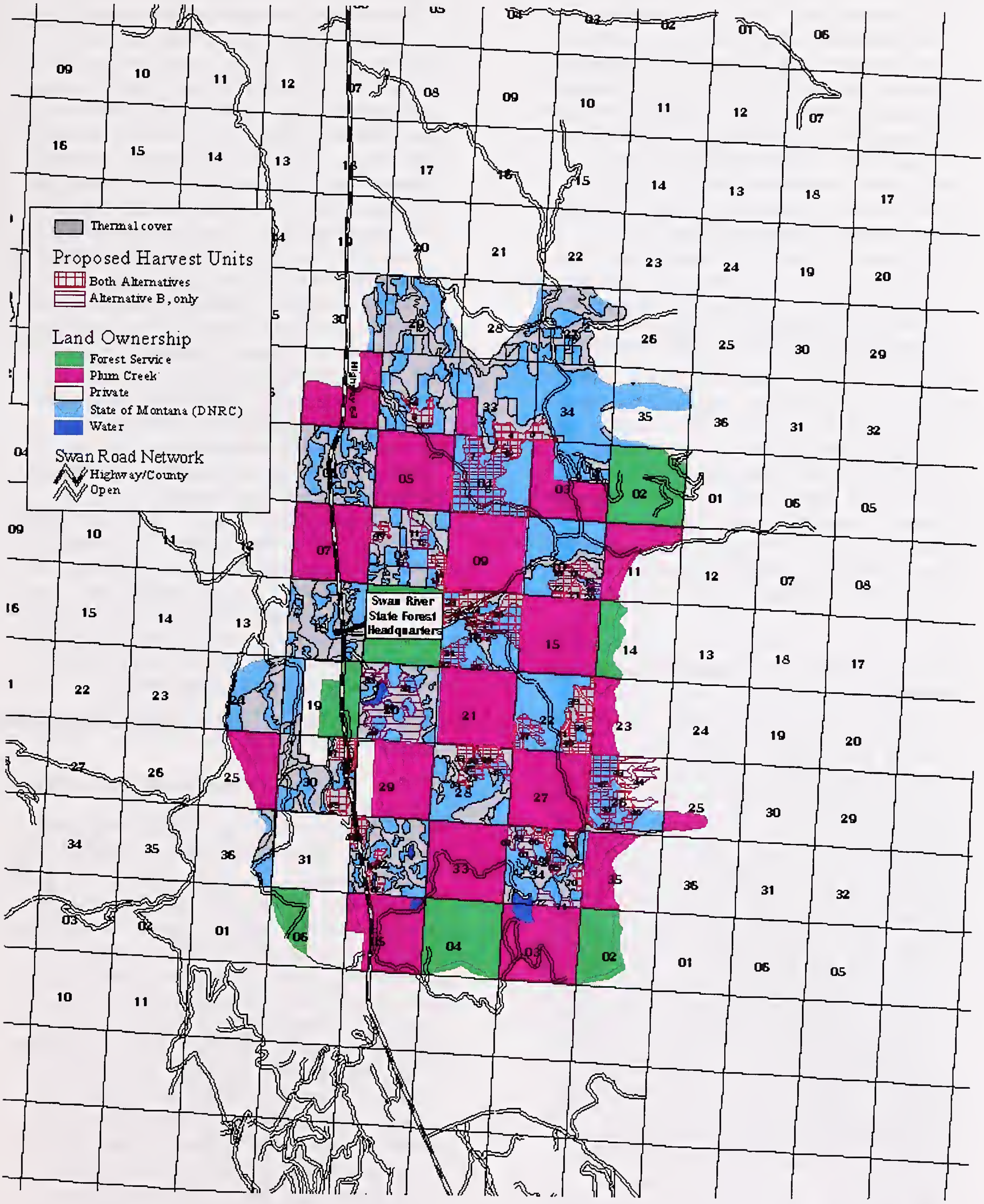
  Timber harvesting is expected to congregate deer in the harvest units to feed on slash. This situation could result in increased movement across the highway and/or snow depths entrapping animals in the harvest units. To mitigate these potential problems, road signs would warn motorists of logging operations and the potential for deer crossing the highway. These signs would be posted during the harvesting of Units 52 through 62. While these animals are concentrated, snow accumulations may prohibit the animals from leaving the area, resulting in high over-winter mortality. The chance of this situation occurring would decrease toward the end of winter. If possible, logging may target the late winter period; however, this is unlikely due to many other constraints (soils, grizzly bears, logging operations, etc.). If deer become "trapped", DNRC would open routes out of the harvest unit to other areas in the winter range using snow machines and/or skis. These trails would allow the deer to move out of the harvest units and disperse throughout the winter range. Neither alternative is expected to result in substantial direct mortality to animals on the winter range.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Big Game***

  Thermal cover would remain at 2,779 acres (43 percent) of the DNRC lands in the winter range analysis area (6,413 acres). Over time, thermal cover is expected to increase as shade-tolerant trees

FIGURE F-6 - BIG GAME SPECIES CUMULATIVE-EFFECTS ANALYSIS AREA AND THERMAL COVER PROVIDED ON DNRC-MANAGED LANDS IN THE ANALYSIS AREA



and trees in harvest units establish and grow. In stands that are providing thermal cover and contain a large percentage of lodgepole pine, thermal cover would be reduced as the lodgepole pine trees die out. The reduced canopy closure by lodgepole pine mortality would occur slowly overtime. During this time, shade-tolerant trees would increase. However, the increase may not compensate for the reduction due to lodgepole pine mortality, resulting in a time lag between the loss and replacement of thermal cover. This time lag is expected to be relatively short. Also, during this time period, past harvest units would continue to regenerate to hiding and thermal cover. Forested travel corridors through the area would be retained. Since thermal cover appears limiting in the area, this alternative is expected to result in positive effects to big game, especially white-tailed deer.

- ***Indirect Effects of Action Alternative B to Big Game***

  Under this alternative, 1,282 acres of thermal cover would be harvested from State trust lands within the winter range, leaving approximately 1,497 acres (23 percent). Since some of these units, or portions of the units, would retain some marginal thermal cover (50 to 70 percent canopy closure), this estimate represents the highest reduction that could occur. The percentage of thermal cover is well below the 50-percent threshold recommended for white-tailed deer by *Jageman (1984)* in Idaho. Under average historic conditions, portions of affected stands would likely have been present in a more open forest condition, providing limited amounts of dense cover; however, the amount and extent that this occurred across the valley is uncertain and likely varied over time. This alternative is expected to substantially decrease the carrying capacity of the winter range for several years (10 to 40 years) until thermal cover is able to redevelop. To reduce vulnerability, visual screening would be retained along all open roads. This alternative could result in appreciable effects to big game species in the area, particularly white-tailed deer during severe winters, by reducing the carrying capacity of this winter range. Reduced carrying capacity could result in increased die-offs of deer during severe winters and a reduced number of deer that could be supported in this local area for several decades. The extent to which big game would be affected is unclear due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of marginal habitat, behavior adaptations, winter severity, and existing population levels. These effects overall would be more pronounced for white-tailed deer than to elk and mule deer.

- ***Indirect Effects of Action Alternative C to Big Game***

  Under this alternative, 875 acres of thermal cover would be harvested from the winter range, leaving approximately 1,904 acres (30 percent). Since some of these units, or portions of the units, would retain some marginal thermal cover (50 to 70 percent canopy closure), this estimate represents the highest reduction that could occur. The percentage of thermal cover is well below the 50-percent threshold recommended for white-tailed deer by *Jageman (1984)* in Idaho. Under average historic conditions, portions of affected stands would likely have been present in a more open forest condition, providing limited amounts of dense cover; however,

the amount and extent that this occurred across the valley is uncertain and likely varied over time. This alternative is expected to substantially decrease the carrying capacity of the winter range for several years (10 to 40 years) until thermal cover is able to redevelop. To reduce vulnerability, visual screening would be retained along all open roads. This alternative could result in appreciable effects to big game species in the area, particularly white-tailed deer during severe winters, by reducing the carrying capacity of this winter range, but less than Action Alternative B. Reduced carrying capacity could result in increased die-offs of deer during severe winters and a reduced number of deer that could be supported in this local area for several decades. The extent to which big game would be affected is unclear due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of marginal habitat, behavior adaptations, winter severity, and existing population levels. These effects overall would be more pronounced for white-tailed deer than to elk and mule deer.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Big Game Species***

  Under No-Action Alternative A, approximately 5,706 acres (46 percent) of thermal cover would be retained on DNRC-managed lands within the analysis area. Through time, canopy cover would continue to increase in the analysis area resulting in an increase in hiding and thermal cover and a decrease in forage production. In time, the existing harvest units on DNRC-managed and Plum Creek Timber Company lands would regenerate into hiding and thermal cover, resulting in increased cover. However, continued harvesting on corporate industrial lands could limit development of thermal cover on these lands. Conversely, USFS lands are expected to retain and/ of develop thermal cover over time. No-Action Alternative A would retain the highest amount of thermal cover in the analysis area and is not expected to alter the existing condition in the short-term. The increase in cover may enhance white-tailed deer and, to a lesser degree, elk winter-range quality, especially in severe winters.

- ***Cumulative Effects Common to Action Alternatives B and C to Big Game Species***

  Under Action Alternatives B and C, reductions of thermal cover would be cumulative to the harvests that occurred on State trust lands, resulting in retention of 4,424 acres (36 percent) and 4,831 acres (39 percent) of thermal cover on DNRC lands, respectively. Thermal cover on corporate private land has been removed and is not expected to be retained in appreciable amounts in the long-term. Conversely, thermal cover on USFS lands is expected to be retained and increase through time. The effects of these alternatives are expected to reduce the carrying capacity of the winter range, especially in severe winters, which could lead to reduced big game populations in the area. However, the extent to which big game would be affected is unclear due to existing potential for dispersal of elk and deer to other nearby habitat, effective use of preferred habitat, behavior adaptations, winter severity, and population levels. Action Alternative B would result in a larger decrease in winter range carrying capacity, than Action Alternative C.

Soils

APPENDIX G

SOILS

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX G

SOILS ANALYSIS

INTRODUCTION

This analysis is designed to disclose the existing condition of the soil resources and display the anticipated effects that may result from each alternative of this proposal.

The concern with soils in regards to the project proposal is two-fold:

- Soil productivity can be reduced depending on area and degree of physical effects (soil compaction and displacement),
- amount of distribution of coarse woody debris retained for nutrient cycling, and
- areas of soil instability could contribute sediment to area streams.

ANALYSIS METHODS

Soil productivity will be analyzed by evaluating the current levels of soils effects in the proposed project area. Analysis criteria will also include soil-stability risk factors.

ANALYSIS AREA

The analysis area for evaluating soil productivity will include DNRC-managed land in the project area. A map of ownership in the project area can be found at the end of this report.

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EXISTING CONDITIONS

The project area is located on moderate to steep slopes with soils weathering from mainly glacial till, outwash, and alluvial deposits. There are no especially unique or unusual geologic features in the sale area. Small areas of marginal slope instability may occur in the general project area of the Perry Creek drainage, but are not included in the proposed harvest units. The project area consists of the soil types summarized in *TABLE G-1 - SOIL TYPES IN THE GOAT-SQUEEZER PROJECT AREA*. Information used to build the table is from the FNF Land System Inventory. A map with the soil map units can be found at the end of this report.

DNRC has conducted timber harvesting in the project area on State land since the 1950s using a combination of ground-based and cable-yarding harvest methods. Ground-based yarding can affect soil productivity through displacement and compaction of productive surface layers of soil, principally on heavy-use skid trails. The proper spacing of skid trails and season-of-use restrictions are the most effective methods to minimize the loss of productivity. An estimated 10 to 15 percent of the area may be affected by existing trails from harvesting in the 1950s, 60s, and 70s. Most trails are well vegetated, and past impacts are beginning to ameliorate from frost and vegetation.

TABLE G-1 - SOIL TYPES IN THE GOAT-SQUEEZER PROJECT AREA

LANDTYPE	LOCATION	GENERAL DESCRIPTION	MANAGEMENT CONSIDERATIONS
10-2 and 10-3	Stream bottoms found along Swan River and in the lower reaches of Goat Creek	Soils vary within the classification, but the majority of soils have a loamy sand surface layer up to 8 inches thick overlying a loamy sand and gravel layer up to 60 inches or more deep.	***Timber*** - Potential high production, tractor operation limited by wet soils. ***Roads*** - Floods have potential to damage stream crossings. Site-specific review recommended. ***Watershed*** - Management of stream crossings has the potential to destabilize channels if not careful. Channel changes can produce large amounts of sediment.
12	Depressions and bogs generally found in the Van Lake watershed	Depressions generally have no well-defined drainage outlet; some contain shallow ponds. Soils are formed in organic deposits of 10 to 60 inches or more. Water tables are at or near the surface during much of the year.	***Timber*** - Poorly suited to timber growth; generally only scattered stands are found. ***Roads*** - Road construction is limited by low soil strength and poor subgrade material. ***Watershed*** - Much of this unit is a riparian area.
26A-7 and 26A-8	Moraines and glaciated mountain slopes on the northern portion of the project area	Slopes range from 10 to 40 percent. Moraines are rolling glacial till deposits with a volcanic ash influence loess surface layer up to 12 inches thick. Drainage pattern is considered 'deranged' on the lower slopes (less than 20 percent), meaning it is a poorly integrated drainage system. This soil type contains quite calcareous subsoils.	***Timber*** - Potential timber production is high. Compaction/displacement is highly probable if season of operation is not properly managed. Carbonates limit root depth. ***Roads***- Roads are well suited to this soil type. Erosion caused by tire treads is a source of fine material. ***Watershed*** - Sediment delivery efficiency is moderate on skid trails and other exposed soils.

LANDTYPE	LOCATION	GENERAL DESCRIPTION	MANAGEMENT CONSIDERATIONS
26C-7 and 26C-8	Moraines and glaciated mountain slopes located throughout the project area	Slopes range from 10 to 40 percent. Moraines are rolling glacial till deposits with a volcanic ash influence loess surface layer up to 12 inches thick. Drainage pattern is considered 'deranged' on the lower slopes (less than 20 percent), meaning it is a poorly integrated drainage system. This soil type varies from the 26A-7 due to less its calcareous nature.	***Timber*** - Potential timber production is high. Compaction/displacement is highly probable if season of operation is not properly managed. ***Roads*** - Roads are well suited to this soil type. Erosion caused by tire treads is a source of fine material. ***Watershed*** - Sediment delivery efficiency is moderate on skid trails and other exposed soils.
26D-7 and 26D-8	Moraines and glaciated mountain slopes on the southern portion of the project area	Slopes range from 10 to 40 percent. Moraines are rolling glacial till deposits with a volcanic ash influence loess surface layer up to 12 inches thick. Drainage pattern is considered 'deranged' on the lower slopes (less than 20 percent), meaning it is a poorly integrated drainage system. This soil type varies from the 26A-7 due to its less calcareous nature and a sandier subsoil, which makes it a very well-drained soil.	***Timber*** - Potential timber production is high. Compaction/displacement is highly probable if season of operation is not properly managed. ***Roads*** - Roads are well suited to this soil type. Erosion caused by tire treads is a source of fine material. ***Watershed*** – Sediment delivery efficiency is moderate on skid trails and other exposed soils.
27-7	Kames, kettles, and terraces in the Squaw/ Perry Watershed	Slopes range from 10 to 20 percent in this landtype with kames and kettles that are a complex pattern of knolls and depressions with a deranged drainage pattern. Bogs and marshes are found in the kettles. Terraces have a dendritic drainage pattern with widely spaced channels. Surface soils are volcanic ash influenced loess up to 10 inches thick. Subsoil in this unit is cobbly, sandy glacial till.	***Timber*** - Potential moderate production, well suited for tractor operation, although displaced soil can lower productivity. ***Roads*** - Roads are well suited to these soils although revegetation may be difficult due to droughtiness. ***Watershed*** - Sediment delivery efficiency is moderate on skid trails and firelines. Material exposed by roads has a slight erosion hazard. Sediment delivery efficiency is low.

LANDTYPE	LOCATION	GENERAL DESCRIPTION	MANAGEMENT CONSIDERATIONS
57-9	Glaciated mountain slopes found in Section 26, T23N, R17W	Slopes range from 40 to 60 percent. Drainage pattern is dendritic and widely space. The surface layer of soil varies from 2 to 22 inches of volcanic ash influenced loess. The subsoil contains up to 80 percent angular and rounded rock fragments.	***Timber*** - Potential moderate production. Slopes limit tractor operation; better suited for cable operation. ***Roads*** - Material exposed by road construction tends to ravel on steep cutbanks. ***Watershed*** - Sediment delivery efficiency is moderate on skid trails and firelines. Material exposed by roads has a slight erosion hazard. Sediment delivery efficiency is moderate.
73	Glacial trough walls — found in Sections 22, 26, and 27, T23N, R17W	Slopes range from 60 to 90 percent. Glacial trough walls contain valley walls of U-shaped glacial valleys. Soil properties vary by location. Volcanic ash-influenced loess for surface lays up to 14 inches thick; upper slopes have a high percentage of angular rock fragments in the subsoil, while the lower slopes have a clay component to the subsoil.	***Timber*** - Potential moderate production on upper slopes and high on lower slopes. Slopes limit tractor operation; better suited for cable operation ***Roads*** - Material exposed by road construction tends to slough on lower slopes. Rock on upper slopes limits excavation. Tread erosion on unsurfaced roads tends to remove fine materials. ***Watershed*** – Sediment-delivery efficiency is moderate on skid trails and firelines. Material exposed by roads has a slight erosion hazard. Sediment delivery efficiency is low on upper slopes and high on lower slopes.
74	Stream breaklands in Section 30 along Perry Creek	Dominant slopes are 60 to 90 percent. Soils are moderately coarse-textured surface layers with weakly developed subsoils. Rock outcrops are common throughout the soil unit.	***Timber*** - Potential moderate production, slopes limit tractor operation; better suited for cable operation. ***Roads*** - Material exposed by road construction tends to ravel on steep cutbanks. Lower elevation revegetation is limited by moisture stress. Slope stability varies and landslides can damage roads. ***Watershed*** – Sediment delivery efficiency is high. Due to the proximity of this landtype to streams, erosion, ravel, or landslides within this unit are likely to become sediment in the streams.

ENVIRONMENTAL EFFECTS

DESCRIPTION OF ALTERNATIVES

- ***No-Action Alternative A***

  No-Action Alternative A involves no timber harvesting, road construction, or related activities.

- ***Action Alternative B***

  Approximately 2,444 acres would be harvested with varying prescriptions ranging from commercial thinning to seedtree. Of the 2,444 acres, 426 acres would be harvested using cable-yarding methods; the remaining 2,018 acres would use ground-based methods.

  Roadwork associated with this alternative includes constructing 4.0 miles of road, reconstructing 3.3 miles, and improving/ maintaining 47.7 miles. The total miles of road proposed for use under this alternative would be approximately 55 miles.

- ***Action Alternative C***

  Approximately 1,866 acres would be harvested with varying prescriptions, ranging from commercial thinning to seedtree. Of the 1,866 acres, 328 acres would be harvested using cable-yarding methods; the remaining 1,538 acres would employ ground-based methods.

  Roadwork associated with this alternative includes constructing 1.8 miles of road and improving/ maintaining 33.6 miles of existing road to a standard that meets BMPs. The total miles of road proposed for use under this alternative would be approximately 35.4 miles.

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Soils***

  Under No-Action Alternative A, no timber harvesting or associated activities would occur. Therefore, no direct effects to soil productivity, other than those already occurring under existing conditions, would result from implementation of this alternative.

- ***Direct Effects Common to Action Alternatives B and C to Soils***

  DNRC expects to maintain long-term soil productivity. The implementation of mitigation measures would control the area and degree of detrimental soil impacts to less than 15 percent of the proposed harvest area. A combination of skidding mitigation measures include:

  - restricting the season of use;
  - utilizing a minimum skid-trail spacing;
  - installing erosion control where needed;
  - retaining woody debris; and
  - following all applicable BMPs.

  Both Action Alternatives B and C include ground-based and cable harvest methods. In addition to the harvest-method requirements, season of operation would be restricted in specific harvest units due to fisheries and/or wildlife concerns.

  Harvesting under winter conditions reduces the potential for compaction and/or displacement of the soil because equipment is less likely to be in direct contact with the soil. Less direct contact with the soil would result in a low risk of displacement and compaction.

  Ground-based harvesting in the summer generally has a higher risk of soil displacement and

compaction due to the direct contact between the equipment and the soil. In order to mitigate the higher potential of impacts during the summer season, skid-trail spacing and soil-moisture restrictions would be specified. Under both action alternatives, skid trails and landings would not exceed 20 percent of the harvest area. Of the 20 percent trafficked by skid trails and landing, 50 percent could expect to result in soil impacts due to heavy use.

Cable yarding would be required on several acres of harvesting under these alternatives. Cable harvested units would not have equipment within the unit. These units would be hand felled instead of mechanically harvested. Soil impacts from the proposed cable yarding would be limited to corridors and, therefore, result in less potential impacted area than ground-based harvesting.

TABLE G-2 - ACRES OF HARVEST AND EXPECTED ACRES OF IMPACT TO SOIL FROM COMPACTION AND DISPLACEMENT BY ALTERNATIVE exhibits the acres of soil impacts expected by alternative if:

- harvest methods and season of operation, as shown in *TABLE G-2 - ACRES OF HARVEST AND EXPECTED ACRES OF IMPACT TO SOIL FROM COMPACTION AND DISPLACEMENT BY ALTERNATIVE,* are followed;
- trafficked areas of skid trails and landings are restricted to 20 percent of the harvest units;
- harvesting conducted during winter operations has a minimum of 3 inches frozen soil, 18 inches loose snow depth, and/or 8 inches of packed snow;

4) summer harvesting restricts harvest-equipment operation to periods of 20 percent or less soil moisture.

Due to the compaction and displacement impacts to the soil, as shown in *TABLE G-2 - ACRES OF HARVEST AND EXPECTED ACRES OF IMPACT TO SOIL FROM COMPACTION AND DISPLACEMENT BY ALTERNATIVE,* DNRC expects short-term reductions in soil productivity from both action alternatives on the displayed acres. As vegetation begins to establish on the impacted areas and freeze-thaw cycles occur, the area of reduced productivity would decrease. Additional mitigation measures to maintain long-term soil productivity can be found at the end of this document.

TABLE G-2 - ACRES OF HARVEST AND EXPECTED ACRES OF IMPACT TO SOIL FROM COMPACTION AND DISPLACEMENT BY ALTERNATIVE

HARVEST METHODS AND SEASON		ACTION ALTERNATIVE B		ACTION ALTERNATIVE C	
		ACRES OF HARVEST	EXPECTED ACRES OF IMPACT	ACRES OF HARVEST	EXPECTED ACRES OF IMPACT
Ground-based	Summer	1,307	196[1]	1,170	176[1]
	Winter	711	28[2]	368	15[2]
Cable		426	43[3]	328	33
Total (acres)			267		178[3]
Total Harvest Acres		2,444	2,444	1,866	1,866
Percent Area Impacted			10.9		10.5

[1]*75 percent of the summer ground-based skid trails may exhibit impacts.*
[2]*20 percent of the winter ground-based skid trails may exhibit impacts.*
[3]*10 percent of the cable ground may exhibit impacts.*

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Soils***

  Under No-Action Alternative A, no timber harvesting or associated activities would occur. Therefore, no indirect effect to sediment delivery would occur if this alternative were implemented.

- ***Indirect Effects Common to Action Alternatives B and C to Soils***

  Indirect effects of Action Alternatives B and C are related to the risk of off-site erosion and slope failure into a stream or other body of water. According to the FNF Land System Inventory, mass failure is unlikely on all of the soil types in the project area, except for a limited area of Soil Type 74 in the northeast corner of Section 8. No harvest units or associated activities are planned on this soil type; therefore, indirect effects would be similar for all alternatives, and no indirect effects to soils are expected from the implementation of Action Alternatives B or C.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Soils***

  Under No-Action Alternative A, no timber harvesting or associated activities would occur. The estimated current area affected by past harvesting is 10 to 15 percent of ground-skidded units. Skid trails are continuing to ameliorate with time as frost and vegetation break up soils and cycle nutrients. Therefore, no additional cumulative effects to sediment delivery would occur as a result of implementing this alternative.

- ***Cumulative Effects Common to Action Alternatives B and C to Soils***

  Cumulative effects to soils may occur from repeated entries into a forest stand where additional ground is impacted by equipment operations. The majority of the areas proposed for harvesting under these alternatives have been harvested in the past using a variety of silvicultural treatments. In order to limit cumulative impacts, existing skid trails would be used if they are properly located and adequately spaced. DNRC would maintain long-term soil productivity and minimize cumulative effects by reusing existing skid trails and mitigating the potential direct and indirect effects with soil-moisture restrictions, season of operation, and method of harvest. In addition, we would retain a portion of coarse woody debris and fine litter for nutrient cycling.

RECOMMENDED MITIGATION MEASURES FOR BOTH ACTION ALTERNATIVES

- Designate skid trails prior to harvesting operations to ensure that the total skid-trail area does not incorporate more than 20 percent of the harvest area.

- Skidding must comply with all BMPs.

- Leave 10 to 15 tons of coarse woody debris, 3 inches and greater in diameter, per acre for nutrient cycling. Leave as much of the needles and fine material as possible in the woods for nutrient cycling.

- Seed disturbed areas with a quick-cover mix to control erosion and reduce the potential for the establishment of noxious weeds.

- Soil moisture conditions must remain at 20 percent or less for operating equipment <u>or</u> winter condition must exist. Winter

conditions include 3 inches of frozen soil or snow depths of 18 inches loose or 8 inches packed.

- Maximum slope for skid trails with conventional equipment will be 40 percent.

Economics

APPENDIX H

ECONOMICS

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX H

ECONOMICS ANALYSIS

INTRODUCTION

The Goat Squeezer Timber Sale Project is located in Swan River State Forest in the southeastern corner of Lake County and near the northeastern corner of Missoula County. The sale is in an area of relatively low population density and has produced timber for the area mills since the 1800s.

The focus of this section will be on:

- market activities that directly or indirectly benefit the Montana education system by generating revenue for the school trust fund, and
- the impact of the alternatives on the local economy and selected socioeconomic institutions.

EXISTING CONDITIONS

This analysis needs to include data from several counties because of the location of Swan River State Forest in relation to the mills that produce lumber, plywood, and pulp and are likely to be interested in the timber. Producers from Lake, Missoula, and Flathead counties are all likely to have an interest in this sale. *TABLE H-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES* contains selected demographic information for each of these counties and the entire State.

TABLE H-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES

DEMOGRAPHIC	FLATHEAD	LAKE	MISSOULA	MONTANA
Population 1990	59,218	21,041	78,687	799,065
Population 2000	74,471	26,507	95,802	902,195
Growth Rate	2.3%	2.3%	2.0%	1.2%
Median Age	37.2	38.2	33.2	37.8
School Enrollment	13,000	4,560	9,400	157,560
Source: Montana Departments of Labor and Commerce and the Office of Public Instruction				

Flathead and Lake counties are widely known for their production of "Flathead cherries" and Christmas tree farms. Lake County encompasses a large part of Flathead Lake and includes much of the Flathead Indian Reservation. Flathead County includes the northern portion of Flathead Lake and the western portion of Glacier National Park. Missoula County has the University of Montana, as well as several timber-processing facilities. Kindergarten through grade 12 school enrollment in the 3 counties totals nearly 27,000. Flathead County is the second largest county in terms of population, but boasts the largest school population of 13,000, almost half of the area's kindergarten through grade 12 school population.

The data in *TABLE H-2 - COVERED WAGES AND EMPLOYMENT DURING 1999 FOR SELECTED INDUSTRIES* shows employment

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TABLE H-2 - COVERED WAGES AND EMPLOYMENT DURING 1999 FOR SELECTED INDUSTRIES

INDUSTRY	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGE (000)	AVERAGE WAGE
Flathead County			
Agriculture, forestry, and fish	346	$6,750	$19,507
Forestry	44	2,176	49,490
Construction	1,855	51,308	27,659
Manufacturing	4,029	133,429	33,117
Lumber	1,911	66,071	34,574
Metals	703	27,522	39,150
Transportation	1,253	35,921	28,668
Trade	8,166	129,864	15,903
Eating and drinking establishments	2,814	26,136	9,288
Finance, insurance, and real estate	1,473	42,639	28,946
Services	8,705	179,250	20,591
Hotels etc.	1,237	15,840	12,805
Amusement and recreation	741	7,921	10,690
Government	4,151	113,387	27,315
Total all industries	30,086	$696,559	$23,152
Lake County			
Agriculture, forestry, and fish	96	$1,325	$13,802
Forestry	13	255	19,615
Construction	370	7,799	21,708
Manufacturing	1,331	32,974	24,774
Lumber	295	9,660	32,745
Metals	NA	NA	NA
Transportation	224	7,485	33,415
Trade	1,762	25,585	14,520
Eating and drinking establishments	586	2,246	9,143
Finance, insurance, and real estate	295	7,388	25,044
Services	3,026	65,724	21,720
Hotels etc.	158	1,779	11,259
Amusement and recreation	64	678	10,594
Government	1,341	32,360	24,131
Total all industries	8,480	$181,340	$21,384
Missoula County			
Agriculture, forestry, and fish	244	$4,618	$18,926
Forestry	44	1,412	32,090
Construction	2,340	67,297	28,760
Manufacturing	3,331	114,960	34,512
Lumber	1,258	42,258	33,591
Metals	75	2,285	30,466
Transportation	2,830	90,614	32,020
Trade	13,208	221,221	16,750
Eating and drinking establishments	4,106	37,633	9,165
Finance, insurance, and real estate	2,194	65,990	30,077
Services	14,693	326,275	22,206
Hotels, etc.	546	5,227	9,573
Amusement and recreation	1,028	10,032	9,760
Government	8,117	241,009	29,692
Total all industries	47,020	$1,134,537	$24,129
Source: Montana Department of Labor and Industry, Research and Analysis Bureau			

and income in the *selected* industry categories for each of the 3 counties included in the analysis. Economic activity within the 3 counties varies substantially, although all 3 counties have some timber-related industry present. Flathead County has a larger number of workers employed in timber-related jobs than Missoula County. Lake County has the smallest labor force and the smallest number of workers employed in this industry. In all 3 counties, timber-related jobs pay more than the average wage in Missoula County; the average wage in the timber industry is 49 percent higher than the average wage for all industries. The corresponding wage comparison numbers for Lake and Flathead counties are 50 percent and 39 percent, respectively. Service industry wages are lower than the average in all 3 counties. The largest difference is in Missoula County where wages in hotels, recreation, and amusement industries are 60 percent of the County-wide average. The service industries provide employment for 2 to 3 times as many workers as the timber industry, but at a substantially lower wage.

ALTERNATIVE EFFECTS

This EIS analyzes 3 options: No-Action Alternative A; Action Alternative B, which harvests in old-growth timber; and Action Alternative C, which does not harvest in old-growth timber.

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Economics***

  None of the employment, income, or trust fund effects that result from the action alternatives would occur with No-Action Alternative A.

- ***Direct Effects of Action Alternatives B and C to Economics***

  Timber Sale Effects

  The estimated revenue and expenditures associated with the Goat Squeezer Timber Sale are shown in *TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE GOAT SQUEEZER TIMBER SALE.* Because no timber-harvesting impacts are associated with No-Action Alternative A, the remaining analysis will focus on the other 2 alternatives. The 2 alternatives analyzed may ultimately be broken into smaller sales, but are treated as a unit for the purpose of this analysis. The volume associated with Action Alternative C is 69,727 tons, or 10.2 MMBF. The corresponding volume for Action Alternative B is 91,324 tons, or 13.4 MMBF. The areas with and without old growth are identified on page C-22 in the *VEGETATION ANALYSIS. TABLE H–3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE GOAT SQUEEZER TIMBER SALE BY ALTERNATIVE* is self-explanatory except for expenditures, which are a combination of estimated costs, primarily development and forest-improvement costs.

TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE GOAT SQUEEZER TIMBER SALE BY ALTERNATIVE

	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Harvest volume (tons)	91,324	69,727
Stumpage price $/ton	$24.20	$22.49
Forest improvement fee (FI)	$701,700	$535,800
Stumpage revenue	$2,210,270	$1,568,200
Trust income	$1,236,330	$817,800
State income	$2,911,970	$2,104,000
Expenditures	$973,940	$750,400

Source: Montana Department of Revenue, Trust Land Management

Stumpage prices, which are currently flat, but below the long-term average, are highly dependent on the housing market, which in turn is dependent on, among other things, the interest rate. The interest rate, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels, which have not been seen since the late 1950s and early 1960s. These low interest rates would normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. The economy is in a period of slow growth. The bombing of the World Trade Center on September 11, 2001 has contributed to the slowness of the general economy. This means that potential homebuyers' incomes are less certain and layoffs that were a result of last years mild recession have not been fully restored. Fixed or lower incomes offset some of the advantages gained through low interest rates and make it more difficult to qualify for a home mortgage. As a result, housing starts, while increasing, are increasing at a lower rate than would be expected with the low interest rates. In addition, mortgage interest rates appear to be increasing, which will offset some of the gains in the other sectors of the economy. These factors have resulted in timber prices at or below historical averages; however, the prices are above last year's lows. The timber prices used in this analysis attempt to recognize the current market conditions. *TABLE H-4 - NUMBER OF STUDENTS SUPPORTED BY ONE YEAR'S ESTIMATED REVENUE* shows the difference in revenue to the trusts from the 2 action alternatives.

The estimated school trust income from Action Alternative C is $817,800, enough to fund the education of 135 students for 1 year, based on an average cost of $6,038, as determined from information provided by the *Montana Office of Public Instruction*. This information is shown in *TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE GOAT SQUEEZER TIMBER SALE*. If the sale does not take place, no students are benefited. Thus, one of the "costs" of not harvesting the timber, compared to harvesting under Action Alternative C, is the loss of financing for 135 kindergarten through grade 12 students for 1 year. If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

The School Trust income from Action Alternative B is estimated to be $1,236,330, enough to fund the education of 204 students for 1 year, based on an average cost of $6,038, as determined by information provided by the *Montana Office of Public Instruction*. This information is shown in *TABLE H-4 - NUMBER OF STUDENTS SUPPORTED BY ONE YEAR'S ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action

TABLE H-4 - NUMBER OF STUDENTS SUPPORTED BY ONE YEAR'S ESTIMATED REVENUE

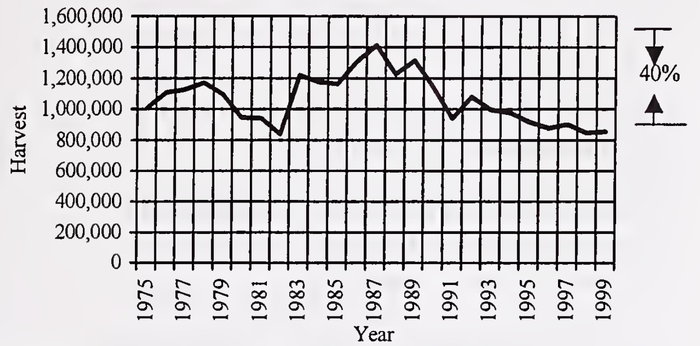
	ACTION ALTERNATIVE	**ACTION ALTERNATIVE**
Estimated School	$1,236,330	$817,800
Students	204	135
Source: Montana Department of Revenue,		

Alternative B is the loss of financing for 204 kindergarten through grade 12 students for 1 year.

Timber-Related Employment

Timber harvesting generates employment. *Keegan et al* estimate that on average 10.58 jobs are created for every MMBF of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns. The marginal effect may be larger or smaller than the average. Empirical evidence would suggest that in a growing industry, marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases the marginal effect of increased or decreased timber sales is "lumpy" (2 sales of the same size under different conditions might induce a larger-than-average employment response in 1 case and a smaller-than-average employment response or nearly negligible employment response in another).

FIGURE H-1—TOTAL TIMBER HARVEST (MBF) FROM MONTANA FORESTS



Source: Montana Department of Natural Resources, Forest

FIGURE H—1 — TOTAL TIMBER HARVEST (MBF) FROM MONTANA FORESTS demonstrates that the amount of timber being harvested in Montana has declined since 1987. The decrease in the harvest since the peak of 1.4 MBF in 1987 has been nearly 40 percent to 854 MBF in 1999. Mills, such as the American Timber Company mill in Olney, have recently closed, citing a lack of available timber as the cause of their foreclosure (Missoulian, *1/12/2000*). All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per MMBF is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment (the average effect on employment should be used since it is the best estimate available) and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per MMBF of wood harvested implies the direct generation of between 108 and 142 jobs and between \$3.7 and \$4.8 million in wages for the alternatives shown in *TABLE H-5 - EMPLOYMENT AND INCOME IMPACTS*. The wages are based on an average wage of \$34,061, as derived from data in *TABLE H-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES*. These are the wages that directly result from the timber harvesting. Without a timber harvest, income would be

TABLE H-5 - EMPLOYMENT AND INCOME

	ACTION ALTERNATIVE B	**ACTION ALTERNATIVE C**
Direct employment	142	108
Wages and salary	\$4,836,700	\$3,678,600
Source: Montana Department of Revenue, Trust Land Management		

lost to the State and communities. As indicated earlier, wages in the timber industry are higher than average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within the timber industry is spent to purchase goods and services elsewhere in the economy. There are also impacts from the logging companies and timber mills when they purchase goods and services from the local economy. Both of these effects are important since they support other community businesses, such as grocery stores, clothing stores, and gas stations. The loss of the income from this sale would mean not only the loss of the direct income, but the loss of the indirect income as well.

The economic impact on the schools occurs through ways other than just the direct contribution to the school trust fund from the revenue generated through timber sales. The wood industry pays taxes on the facilities it owns and operates. In the year 2000, the wood industry paid taxes of nearly $1,914,000 to the schools in Flathead, Lake, and Missoula counties. The tax contribution, however, is expected to decline in the future with the closure of American Timber Company in Flathead County, which will reduce the tax base by an estimated $4.4 million, thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 5 students per year.

OTHER INDIRECT EFFECTS

Indirect economic impacts are much broader than those identified in the previous section. Some of these impacts are the result of the money from the sales "recycling" through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of the grocery store employee, the grocery store employees use that money to purchase groceries for themselves. This, in turn, generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to demonstrate secondary effects is not available. In a broader State-wide context, money paid to wood-industry workers results in increased State income-tax collections, as well as increased purchases in other areas of the State. Income-tax collections from the wages of millworkers, alone, are estimated to generate between $182,000 and $189,000 in State tax revenue, depending on which alternative is selected. Taxes on indirect wages would add to this tax amount. Since the State revenue is spent on projects State-wide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout the State.

Nonmarket Issues

Quantitative analyses of the economic value of nonmarket benefits and costs will not be part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows.

A brief description of the biological impacts is included in

order to identify areas where economic values might be affected. A more-detailed discussion of the biological impacts is found in other sections of the report.

- ***Environmental Modifications***

  The timber harvesting would modify the undisturbed development of the forest and, as a result, would affect both the short- and long-term habitat and wildlife regimes. How individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. Modifying the undisturbed development of the areas would likely limit the use of the area by some species of wildlife in the short run and, potentially, limit the use by other species in the longer term. Wildlife impacts from the logging activities are expected to be temporary and comparatively small. The estimation of the net social benefit or loss of these impacts is an empirical issue that does not directly affect the school trust fund.

- ***Human Use***

  The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the use of these areas is likely to decline or change during the period of logging, long-term overall use of the area is expected to remain high. Some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. The aesthetics would be modified, and while some individuals would view this as a loss, others may prefer the more open forest that would result from the harvest. Visual changes are minimized to the extent practicable by limiting the trees harvested in some areas and by "sculpting cuts" to avoid "unnatural" visual lines. Some activities may be enhanced. For instance the logged area may enhance the habitat of some game species and the increased use of areas by those game species may make the area more attractive to hunters. As in the case of the environmental modifications, the net social benefit or loss is an empirical issue dependent on individual values.

- **Social Impacts**

  The area has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. The timber sale is unlikely to add sufficient pressures to these institutions to require their modification. A high rate of employment (low rate of unemployment) is associated with lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the social impact of timber harvesting might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact would be positive.

- **Roads**

  New roads would be constructed for the sale(s). Existing roads would be improved to handle the logging trucks and provide transport for other equipment used in timber harvesting. Expenditures for road improvements are identified in both alternatives as part of the cost of sale development. Some improvements are also funded through FI fees, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, they would improve local economic conditions.

A portion of the money would leave the area and provide income for other areas of the State and national economies. The culverts, for example, may come from manufacturers outside of Montana; however, most of the road improvement expenditures would remain in Montana.

- **Population Impacts**

  Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

Underlying Assumptions

Project-impact estimation and analysis assumes that most of the economic impact associated with the sales would take place in the 3-county area. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible.

The FI fee is for a program to provide funding for forest development and improvement, and is collected from the logging company as part of their bid. Activities funded under the FI program include site preparation, tree planting, thinning, roadwork, and right-of-way acquisition. The current FI fee for the NWLO area is $52.25 per MBF.

Most of the economic impacts associated with this sale are short term. If no other trees were available for harvesting after this timber sale, the tendency would be to return to a lower level of economic activity. A short-term impact that might occur as the local economy contracts might be an increase in unemployment as local employers adjust to the lowered production levels.

CUMULATIVE EFFECTS

This sale would be part of the annual harvest of timber from the State of Montana forest trust lands. The net revenue from this sale would add to the trust fund. Annual trust fund contributions have varied widely over the years, because the actual contribution to the trust is more a function of harvesting than of sales. Harvesting levels can vary substantially over time; sales tend to be more consistent. *TABLE H-6 - ANNUAL REVENUE FROM TMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual revenue from harvesting for the last 5 years. The contribution to the trust fund is also affected by the annual costs experienced by the Department for program management, which varies from year to year. DNRC should continue to make annual contributions to the trust from its forest management program.

TABLE H-6 - ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS

Year	Harvest Revenue
2001	$8,524,150
2000	$12,710,311
1999	$6,998,847
1998	$8,393,485
1997	$7,327,641

DNRC has a State-wide sustained-yield annual harvest goal of 42.164 MMBF. If timber from this project is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and not benefit this region of the State. Long-term deferrals of harvesting from this forest would impact harvest patterns, changing both the region in which the trees are harvested and the volumes taken. This would impact other areas of the State where these changes occur.

APPENDIX I

RECREATION

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX I

RECREATION ANALYSIS

INTRODUCTION

The Goat Squeezer Timber Sale Project area currently experiences moderate recreational use by the general public.

METHODS

The methodologies used to portray the existing condition and determine recreational impacts of the project include determining the recreational uses, approximate revenue, and the potential for conflict between project activities and recreational uses.

ANALYSIS AREA

The analysis area includes all legally accessible lands within the Goat Squeezer Timber Sale Project area (Goat Creek and Squeezer Creek watersheds) and the roads that would be used to haul equipment and logs.

EXISTING CONDITION

The Goat Squeezer Timber Sale Project area receives moderate recreational use throughout the year. The area is primarily used for berry picking, snowmobiling, bicycling, fishing, hiking, hunting, and some camping. The 4 main roads that provide access to the Swan Mountains include Goat Creek, Squeezer Creek, Old Squeezer Loop, and Center Loop roads.

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There are currently 3 separate outfitting licenses: 1 for spring black bear ($700.00 annually), 1 for big game ($2,600.00 annually), and 1 for mountain lion ($1,850.00 annually). The total annual return on hunting outfitting is $5,150.00, which, spread across Swan River State Forest, is approximately $0.13/acre. Also, 6 river-outfitter licenses are available for fishing on Swan River. The river outfitters pay an annual fee of $200.00 each, for a total return of $1,200.00 a year.

State lands are available for nonmotorized recreational use to anyone purchasing a General Recreational Use License. Licenses are not site specific and allow use of all legally accessible State lands; therefore, it is very difficult to determine the amount of recreational use and income resulting from the sale of licenses for a specific area. From July 1, 2000 to June 30, 2001, the total gross revenue to the school trust from General Recreational Use Licenses was approximately $294,000.00. There are approximately 5,147,172 acres of school trust land State-wide (DNRC Annual Report 2001). Therefore, the average gross revenue is approximately $0.057/ acre ($294,000.00 divided by 5,147,172 acres) for the 2001 fiscal year.

Applying the Statewide average revenue per acre to the State land within the project area (approximately 10,676 acres), the lands produced an estimated revenue of $608.53 from General Recreational Use Licenses, assuming the project

area receives an average amount of paid recreational use.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Recreation***

  Recreational uses and revenue would not change.

- ***Direct Effects of Action Alternatives B and C to Recreation***

  Harvesting activities may disturb normal game-movement patterns, which may affect hunter success. Short delays due to log hauling, snowplowing, and road construction may inconvenience snowmobilers, bicyclists, and other recreationists. However, recreational use and revenue income from outfitting and General Recreational Use Licenses are not expected to change with the implementation of this project.

  The open-, restricted-, and closed-road status would not change with the implementation of this project.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Recreation***

  No change is anticipated.

- ***Indirect Effects of Action Alternatives B and C to Recreation***

  The amount of recreational use within the project area may change. Recreational users may use adjacent areas to avoid harvesting and log-hauling activities. Recreational use and revenue income from outfitting and General Recreational Use Licenses are not expected to change as this project is implemented.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Recreation***

  Some recreational users may be reluctant to use roads within the project area if roads continue to deteriorate. However, recreational use and revenue income from outfitting and General Recreational Use Licenses are not expected to change.

- ***Cumulative Effects of Action Alternatives B and C to Recreation***

  The combined harvesting and log-hauling activities of this project and Plum Creek Timber Company projects within the project area may displace recreational use to adjacent areas outside the project area. All levels of existing recreational use on Swan River State Forest are expected to continue. Therefore, revenue income from outfitting and General Recreational Use Licenses are not expected to change.

Air Quality

APPENDIX J

AIR QUALITY

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX J

AIR QUALITY

INTRODUCTION

Air quality could be affected by smoke from project-related logging slash and prescribed burning. Air quality may also be affected by road dust created from harvesting and log-hauling activities.

METHODS

The methodologies used to analyze effects to air quality include estimating the location, amount, and timing of smoke and dust generated by project-related activities.

ANALYSIS AREA

The analysis area for air quality includes all of Lake County, which is a part of Montana Airshed 2 as defined by the Montana Airshed Group.

EXISTING CONDITION

Currently, the project area contributes very low levels of air pollution into the analysis area or local population centers. Temporary reductions to air quality from the project area exist in the summer and fall due to smoke generated from prescribed burns and dust produced by vehicles driving on dirt roads. None of the air-quality reductions affect local population centers beyond EPA standards. All burning activities by major burners comply with emission levels authorized by the Montana Airshed Group. The project area is outside any of the local impact zones, where additional restrictions may be imposed to protect air quality.

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ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Direct Effects Common to Action Alternatives B and C to Air Quality***

  Postharvest burning would produce smoke emissions; log hauling and other project-related traffic on dirt roads would increase road dust during dry periods. No increase in emissions is expected to exceed standards or impact local population centers provided that burning is completed within the requirements imposed by the Montana Airshed Group and dust abatement is applied to roads during dry periods.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Indirect Effects Common to Action Alternatives B and C to Air Quality***

  Since emissions are expected to remain within the air-quality standards, no indirect effects to human health at local population

centers are anticipated.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Cumulative Effects Common to Action Alternatives B and C to Air Quality***

  Additional smoke produced from prescribed burning on adjacent USFS, private industrial forestlands, and State school trust lands would remain within the standards for air quality, but the cumulative effects during peak burning periods could affect individuals with respiratory illnesses at local population centers for short durations. All known major burners operate under the requirements of the Montana Airshed Groups, which regulate the amount of emissions produced cumulatively by major burners.

Aesthetics

APPENDIX K

AESTHETICS

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX K

AESTHETICS ANALYSIS

INTRODUCTION

The public generally views the project area while sightseeing. The views of vegetation and topography that are next to roads or trails are known as foreground views. The views of hillsides or drainages from roads and trails are known as middleground views. The views of horizons, mountain ranges, or valleys are known as background views. The existing condition and the impacts to the current views are presented from the perspective of these 3 viewing categories. The foreground and middleground views are discussed in regard to changes in vegetation, soil, and timber stands along roads. Background views were analyzed based on the openness of the proposed harvest areas and the patterns of trees that would be left in those areas. The analysis areas for the foreground and middleground views are along Goat Creek, Squeezer Creek, Old Squeezer Loop, and Center Loop roads. The analysis area for background views is the central Swan Range on the east side of Swan River State Forest, as viewed from Highway 83.

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EXISTING CONDITION

Generally, foreground views along open roads are limited to 200 feet and contain views of open and dense forest stands and openings caused by postharvest activities. Firewood gathering and salvage logging have caused some damage to live trees; limbs and tops are scattered along roads and ditches.

Middleground views are being able to view 200 to 1,000 feet from a road or trail and usually consist of hillsides or drainages. On State ownership, areas that have been harvested in the past range in size from 10 to 150 acres and have a dense cover of 6- to 40-foot trees. Plum Creek Timber Company land has been heavily harvested by using widespread clearcut, seedtree, and selective harvest methods. Typically, these harvests have left openings of hundreds of acres. The harvest unit boundaries usually follow section lines and appear harsh and unnaturally straight.

Background views of the project area are a collection of drainages and ridges that make up a portion of the central Swan Range. The vegetation is a mixture of dense mature forests and past harvest units. Past harvest units range from having few trees to dense retentions of mature trees and abundant tree regeneration.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Aesthetics***

  In the short term, shrubs and trees would continue to grow along the roads and limit views.

- ***Direct Effects of Action Alternative B to Aesthetics***

  Action Alternative B utilizes a variety of treatment methods, which include commercial thinning, group selection, sanitation, seedtree, individual tree selection, and shelterwood. Treatments would aesthetically affect the harvest area by:

  - opening the view;
  - causing some damage to vegetation;
  - creating logging slash;
  - disturbing soil along skid trails, landings, and while constructing new roads; and
  - creating landing piles along roads in the project area.

  For the most part, foreground views would be altered and have fewer trees. In some areas, treatments would allow for views of the middleground. The middleground views would appear altered and have fewer trees. The background views of this alternative would appear altered and show a variety of tree spacings remaining on the landscape. These units would be visible from Highway 83.

- ***Direct Effects of Action Alternative C to Aesthetics***

  Action Alternative C is very similar to Action Alternative B. Action Alternative C would utilize a variety of treatment methods, which include commercial thinning, sanitation, shelterwood, seedtree, and individual-tree selection. Treatments would aesthetically affect the harvest area by:

  - opening the view;
  - causing some damage to vegetation;
  - creating logging slash;
  - disturbing soil along skid trails, landings, and while constructing new roads; and
  - creating landing piles along roads in the project area.

  The foreground views would be altered and have fewer trees. Some of these foreground views would be visible from Highway 83. In some areas treatments would allow for views of the middleground. The middleground views would also appear altered and have fewer trees.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Aesthetics***

  Aesthetics would not be indirectly affected by this alternative.

- ***Indirect Effects of Action Alternatives B and C to Aesthetics***

  For units that would be treated by seedtree or group selection methods, the area treated would appear similar to the results of a moderately severe fire. For the other treatment-type areas, the trees remaining would appear similar to the results of a low-intensity fire of mixed severity. In both situations, the species retained may differ from the species that would survive these types of fires.

CUMULATIVE EFFECTS

The following effects of other projects may occur in addition to the direct and indirect effects of this project:

- Natural processes on the landscape, such as wildfires, windstorms, insect infestations, and disease infections, would continue to alter the view over time.

- In the short term, effects to the view would be from present activities, such as firewood gathering and timber harvesting, on adjacent Plum Creek Timber Company lands and State ownership.
- Salvage harvesting and firewood gathering would alter foreground views by damaging vegetation along roads and leaving some debris on road surfaces and in ditches. The administration of salvage permits by DNRC would keep roadside debris at a minimum. Middleground and background viewing would remain unaltered.
- DNRC is planning other harvesting projects in the areas of Napa, Soup, and Cilly creeks, which are located north of the project area. Currently, environmental documents are being written and units are being chosen. Harvest units may only affect foreground and/or middleground viewing in the area.

Glossary

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX L

GLOSSARY

Acre-foot
A measure of water or sediment volume equal to an amount of material that would cover 1 acre to a depth of 1 foot.

Action alternative
One of several ways of moving toward the project objectives.

Adfluvial
A fish that out migrates to a lake as a juvenile to sexually mature and returns to natal stream to spawn.

Administrative road use
Road use that is restricted to DNRC personnel and contractors for purposes such as monitoring, forest improvement, fire control, hazard reduction, etc.

Airshed
An area defined by a certain set of air conditions; typically a mountain valley where air movement is constrained by natural conditions such as topography.

Ameliorate
To make better; improve.

Appropriate conditions
Describes the set of forest conditions determined by DNRC to best meet the SFLMP objectives. The 4 main components useful for describing an appropriate mix of conditions are cover-type proportions, age-class distributions, stand-structure characteristics, and the spatial relationships of stands (size, shape, location, etc.); all are assessed across the landscape.

Background view
Views of distant horizons, mountain ranges, or valleys from roads or trails.

Best Management Practices (BMPs)
Guidelines to direct forest activities, such as logging and road construction, for the protection of soils and water quality.

Biodiversity
The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems where they occur.

Board foot
144 cubic inches of wood that is equivalent to a piece of lumber 1-inch thick by 1 foot wide by 1 foot long.

Canopy
The upper level of a forest consisting of branches and leaves of the taller trees.

Canopy closure
The percentage of a given area covered by the crowns, or canopies, of trees.

Cavity
A hollow excavated in trees by birds or other animals. Cavities are used for roosting and reproduction by many birds and mammals.

Centimeter
A distance equal to .3937 inch.

Commercial-thin harvesting
A harvest that cuts a portion of the merchantable trees within a stand to provide growing space for the trees that are retained. For the South Wood Timber Sale Project, thinning would reduce stand densities to approximately 100 trees per acre.

Compaction
The increase in soil density caused by force exerted at the soil surface, modifying aeration and nutrient availability.

Connectivity
The quality, extent, or state of being joined; unity; the opposite of fragmentation.

Core area
See Security Habitat (grizzly bears).

Cover
See HIDING COVER and/or THERMAL COVER.

Coarse down woody material
Dead trees within a forest stand that have fallen and begun decomposing on the forest floor.

Crown cover or crown closure
The percentage of a given area covered by the crowns of trees.

Cull
A tree of such poor quality that it has no merchantable value in terms of the product being cut and manufactured.

Cutting or harvest units
Areas of timber proposed for harvesting.

Cumulative effect
The impact on the environment that results from the incremental impact of the action when added to other actions. Cumulative impacts can also result from individually minor actions, but collectively they may compound the effect of the actions.

Direct effect
Effects on the environment that occur at the same time and place as the initial cause or action.

Discounting
In economics, a method of accounting for the value of money over time, its ability to earn interest, so that costs and benefits occurring at different points in time are brought to a common date for comparison.

Ditch relief
A method of draining water from roads using ditches and a corrugated metal pipe. The pipe is placed just under the road surface.

Dominant tree
Those trees within a forest stand that extend their crowns above surrounding trees and capture sunlight from above and around the crown.

Drain dip
A graded depression built into a road to divert water and prevent soil erosion.

Ecosystem
An interacting system of living organisms and the land and water that make up their environment; the home place of all living things, including humans.

Embeddeness
Embeddedness refers to the degree of armour, or the tight consolidation of substrate.

Environmental effects

The impacts or effects of a project on the natural and human environment.

Equivalent clearcut area (ECA)
The total area within a watershed where timber has been harvested, including clearcuts, partial cuts, roads, and burns.

Allowable ECA - The estimated number of acres that can be clearcut before stream-channel stability is affected.

Existing ECA - The number of acres that have been previously harvested taking into account the degree of hydrologic recovery that has occurred due to revegetation.

Remaining ECA -The calculated amount of harvesting that may occur without substantially increasing the risk of causing detrimental effects to stream-channel stability.

Excavator piling
The piling of logging residue (slash) using an excavator.

Fire regimes
Describes the frequency, type, and severity of wildfires. Examples include: frequent, nonlethal underburns; mixed-severity fires; and stand-replacement or lethal burns.

Fluvial
A fish that outmigrates to a river from its natal stream as a juvenile to sexually mature in the river, and returns to its natal stream to spawn.

Forage
All browse and nonwoody plants available to wildlife for grazing.

Foreground view
The view immediately adjacent to a road or trail.

Forest improvement (FI)
The establishment and growing of trees after a site has been harvested. Associated activities include:

- site preparation, planting, survival checks, regeneration surveys, and stand thinnings;
- road maintenance;
- resource monitoring;
- noxious weed management; and
- right-of-way acquisition on a State forest.

Fragmentation (forest)
A reduction of connectivity and an increase in sharp stand edges resulting when large contiguous areas of forest with similar age and structural characteristics are interrupted through disturbances, such as stand-replacement fires and timber stand harvesting.

Habitat
The place where a plant or animal naturally or normally lives and grows.

Habitat type
Land areas that would produce similar plant communities if left undisturbed for a long period of time.

Hazard reduction
The abatement of a fire hazard by processing logging residue with methods such as separation, removal, scattering, lopping, crushing, piling and burning, broadcast burning, burying, and chipping.

Hiding cover
Vegetation capable of hiding 90 percent of a standing adult mammal from human view at a distance of 200 feet.

Historical forest condition
The condition of the forest prior to settlement by Europeans.

Indirect effects
Secondary effects that occur in locations other than the initial action or significantly later in time.

Inoculum
The material (spore) used to introduce a disease in order to immunize, cure, or experiment.

Intermediate trees
Characteristics of certain tree species that allow them to survive in relatively low-light conditions, although they may not thrive.

Interdisciplinary team (ID Team)
A team of resource specialists brought together to analyze the effects of a project on the environment.

Landscape
An area of land with interacting ecosystems.

Kairomone
Chemicals emitted by a plant that act as attractants to insects (ex. The volatiles emitted by a root-diseased tree that make them attractive to bark beetles).

Kilometer
A distance equal to 3,280.8 feet or .621 mile.

McNeil Coring
McNeil coring is a method used to determine the size range of material in streambed spawning sites.

Meter
A distance equal to 39.37 inches.

Middleground view
The view that is 200 to 1,000 feet from a road or trail, usually consisting of hillsides and drainages.

Millimeter
A distance equal to .03937 inch.

Mitigation measure
An action or policy designed to reduce or prevent detrimental effects.

Multistoried stands
Timber stands with 2 or more distinct stories.

Nest site area (bald eagle)
The area in which human activity or development may stimulate the abandonment of the breeding area, affect successful completion of the nesting cycle, or reduce productivity. It is either mapped for a specific nest, based on field data, or, if that is impossible, is defined as the area within a ¼-mile radius of all nest sites in the breeding area that have been active within the past 5 years.

No-action alternative
The option of maintaining the status quo and continuing present management activities by not implementing the proposed project.

Nodal habitats

Nonforested area
A naturally occurring area, (such as a bog, natural meadow, avalanche chute, and alpine areas) where trees do not establish over the long term.

Old growth
Working definition - Old growth as defined by *Green et al.*
Conceptual definition - The term old growth is sometimes used to describe the later, or older, stages of natural development of forest stands. Characteristics associated with old-growth generally include relatively large old trees that contain a wide variation in tree sizes, exhibit some degree of a multi-storied structure, have signs of decadence, such as rot and spike-topped structure, and contain standing large snags and large down logs.

Old-growth network
A collection of timber stands that are selected to meet a management strategy that would retain and recruit 150+-year-old stands over the long term (biodiversity, wildlife, the spatial arrangement of stands and their relationship to landscape patterns and processes) are elements that are considered in the selection of stands.

Overstory
The level of the forest canopy that include the crowns of dominant, codominant, and intermediate trees.

Patch
A discrete (individually distinct) area of forest connected to other discrete forest areas by relatively narrow corridors; an ecosystem element (such as vegetation) that is relatively homogeneous internally, but differs from what surrounds it.

Potential nesting habitat (bald eagle)
Sometimes referred to as 'suitable nesting habitat', areas that have no history of occupancy by breeding bald eagles, but contain potential to do so.

Project file
A public record of the analysis process, including all documents that form the basis for the project analysis. The project file for the South Wood Timber Sale Project EIS is located at the Swan River State Forest headquarters office at Goat Creek.

Redds
The spawning ground or nest of various fish species.

Regeneration
The replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.

Relict
A scientific term used when talking about trees left over from fires, residual soil or geologic features, etc.; something that has survived destructive processes.

Resident
Pertaining to fish, resides and reproduces in natal stream.

Residual stand
Trees that remain standing following any cutting operation.

Road-construction activities
In general, "road-construction activities" refers to all activities conducted while building new roads, reconstructing existing roads, and obliterating roads. These activities may include any or all of the following:

- constructing road
- clearing right-of-way
- excavating cut/fill material
- installing road surface and ditch drainage features
- installing culverts at stream crossings
- burning right-of-way slash
- hauling and installing borrow material
- blading and shaping road surfaces

Road improvements
Construction projects on an existing road to improve the ease of travel, safety, drainage, and water quality.

Saplings
Trees 1.0 inches to 4.0 inches in dbh.

Sawtimber trees
Trees with a minimum dbh of 9 inches.

Scarification
The mechanized gouging and ripping of surface vegetation and litter to expose mineral soil and enhance the establishment of natural regeneration.

Scoping
The process of determining the extent of the environmental assessment task. Scoping includes public involvement to learn which issues and concerns should be addressed and the depth of the assessment that will be required. It also includes a review of other factors such as laws, policies, actions by other landowners, and jurisdictions of other agencies that may affect the extent of assessment needed.

Security
For wild animals, the freedom from the likelihood of displacement or mortality due to human disturbance or confrontation.

Security habitat (grizzly bears)
An area of a minimum of 2,500 acres that is at least 0.3 miles from trails or roads with motorized travel and high-intensity, nonmotorized use during the nondenning period.

Seedlings
Live trees less than 1.0 inch dbh.

Seedtree harvesting
Removes all trees from a stand except for 6 to 10 seed-bearing trees per acre that are retained to provide a seed source for stand regeneration.

Sediment
Solid material, mineral or organic, that is suspended and transported or deposited in bodies of water.

Sediment yield
The amount of sediment that is carried to streams.

Seral
Refers to a biotic community that is in a developmental, transitional stage in ecological succession.

Shade intolerant
Describes tree species that generally can only reproduce and grow in the open or where the overstory is broken and allows sufficient sunlight to penetrate. Often these are seral species that get replaced by more shade-tolerant species during succession. In Swan River State Forest, shade-intolerant species generally include ponderosa pine, western larch, Douglas-fir, western white pine, and lodgepole pine.

Shade tolerant
Describes tree species that can reproduce and grow under the canopy in poor sunlight conditions. These species replace less shade-tolerant species during succession. In Swan River State Forest, shade-tolerant species generally include subalpine fir, grand fir, Douglas-fir, Engelmann spruce, western hemlock, and western red cedar.

Sight distance
The distance at which 90 percent of an animal is hidden from view by vegetation.

Silviculture
The art and science of managing the establishment, composition, and growth of forests to accomplish specific objectives.

Site Preparation
A hand or mechanized manipulation of a harvested site to enhance the success of regeneration. Treatments are intended to modify the soil, litter, and vegetation to create microclimate conditions conducive to the establishment and growth of desired species.

Slash
Branches, tops, and cull trees left on the ground following harvesting.

Snag
A standing dead tree or the portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

Spur roads
Low-standard roads that are constructed to meet minimum requirements for harvesting-related traffic.

Stand
An aggregation of trees that are sufficiently uniform in composition, age, arrangement, and condition and occupy a specific area that is distinguishable from the adjoining forest.

Stand density
Number of trees per acre.

Stocking
The area of a piece of land that is now covered by trees is compared to what could ideally grow on that same area. The comparison is usually expressed as a percent.

Stream gradient
The slope of a stream along its course, usually expressed in percentage, indicating the amount of drop per 100 feet.

Stumpage
The value of standing trees in the forest. Sometimes used to mean the commercial value of standing trees.

Substrate scoring
Rating of streambed particle sizes.

Succession
The natural series of replacement of one plant (and animal) community by another over time in the absence of disturbance.

Suppressed
The condition of a tree characterized by a low-growth rate and low vigor due to overcrowding competition with overtopping trees.

Texture
A term used in visual assessments indicating distinctive or identifying features of the landscape depending on distance.

Thermal cover
For white-tailed deer, thermal cover has 70 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller. For elk and mule deer, thermal cover has 50 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller.

Timber-harvesting activities
In general, all the activities conducted to facilitate timber removal before, during, and after the timber is removed. These activities may include any or all of the following:

- felling standing trees and bucking them into logs
- skidding logs to a landing
- processing, sorting, and loading logs at the landing
- hauling logs to a mill
- slashing and sanitizing residual vegetation damaged during logging
- machine piling logging slash
- burning logging slash
- scarifying, preparing the site as a seedbed
- planting trees

Understory
The trees and other woody species growing under a, more-or-less, continuous cover of branches and foliage formed collectively by the overstory of adjacent trees and other woody growth.

Uneven-aged stand
Various ages and sizes of trees growing together on a uniform site.

Ungulates
Hoofed mammals, such as mule deer, white-tailed deer, elk, and moose, that are mostly herbivorous and many are horned or antlered.

Vigor
The degree of health and growth of a tree or stand.

Visual screening
The vegetation that obscures or reduces the length of view of an animal.

Watershed
The region or area drained by a river or other body of water.

Water yield
The average annual runoff for a particular watershed expressed in acre-feet.

Water yield increase
An increase in average annual runoff over natural conditions due to forest canopy removal.

APPENDIX M

PEOPLE CONTACTED

GOAT SQUEEZER TIMBER SALE PROJECT

APPENDIX M

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GOAT SQUEEZER TIMBER SALE PROJECT

ACRONYMS

AF	Subalpine fir
ARM	Administrative Rules of Montana
BMP	Best Management Practices
C.	Celcius
cm	Centimeter
dbh	Diameter at Breast Height
DEQ	Department of Environmental Quality
DF	Douglas-fir
DFWP	Montana Department of Fish, Wildlife and Parks
DEIS	Draft Environmental Impact Statement
DNRC	Department of Natural Resources and Conservation
EA	Environmental Assessment
EAC	Environmental Assessment Checklist
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FNF	Flathead National Forest
FOGI	Full Old-Growth Index
ID Team	Interdisciplinary Team
LPP	Lodgepole pine
m	Meter
m^3	Cubic millimeter
MBF	thousand board feet
MC	Mixed conifer
MCA	Montana Codes Annotated
MEPA	Montana Environmental Policy Act
mm	Millimeter
MMBF	Million Board Feet
NCDE	Northern Continental Divide Ecosystem
NWLO	Northwestern Land Office
PP	Ponderosa pine
SB	Senate Bill
SFLMP	State Forest Land Management Plan
SLI	Stand-level Inventory
SMZ	Streamside Management Zone
SVGBCA	Swan Valley Grizzly Bear Conservation Agreement
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WL/DF	Western larch/Douglas-fir
WWP	Western white pine

124 Permit	Stream Preservation Act Permit
318 Authorization	A Short-term Exemption from Montana's Surface Water Quality Standards
Land Board	State Board of Land Commissioners

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